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BY

ARTHUR MESSINGER COMEY, Ph.D.
FORMERLY PROFESSOR OF CHEMISTRY, TUFTS COLLEGE

London
MACMILLAN AND CO.
AND NEW YORK
1896

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1896

TO

HIS TEACHER, ADVISER, AND FRIEND

Charles Loring Jackson

ERVING PROFESSOR OF CHEMISTRY, HARVARD UNIVERSITY

THIS VOLUME IS DEDICATED

WITH THE HIGHEST RESPECT AND KINDEST REGARDS

OF

THE AUTHOR

PREFACE

For many years a need has been felt by chemists for a book which shall collect into convenient form for ready reference the various data concerning the solubility of chemical substances that have been published from time to time in chemical periodicals and elsewhere.

The first mention that can be found of such a plan was made in 1731, when Peter Shaw delivered Chemical Lectures in London, as may be seen from the following:—

> Extracts from Peter Shaw's Chemical Lectures, publickly read at London in 1731 and 1732. London. Second Edition, London 1755. 8vo.
>
> Page 97. Experiment I.—That Water as a Menstruum dissolves more of one body and less of another.
>
> [He shows that two ounces of water dissolve two ounces of Epsom salt, five drachms of common salt, and eight grains of cream of tartar. Only in the latter case much remained undissolved until boiled.]
>
> "It might be proper for the further Improvement of Chemistry and Natural Philosophy to form a Table of the Time and Quantity wherein all the known Salts are dissolvable in Water. . . . Such a Table regularly formed might ease the Trouble of refining Salts, by shewing at once without future Trial or Loss of Time how much Water each Salt required to dissolve it for Clarification, Filtration, or Crystallization. It would likewise supply us with a ready and commodious Way of separating any Mixture of Salts, by shewing which would first shoot out of the Mixture upon Crystallization. . . . The same Table might also direct us to a ready and commodious Method of separating two Salts without waiting for Crystallization. . . ."

It was many years, however, before the scheme suggested by Peter Shaw was put into execution. Professor F. H. Storer published the first work that undertook to carry out the idea in its entirety, in 1864, in a book, which he entitled "First Outlines of a Dictionary of Solubilities of Chemical Substances," and which contained a compilation of nearly all the data on the

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subject published before 1860. It was at once recognised as a most valuable contribution to chemical literature; but for many years it has been difficult to obtain this work, as the limited edition which was published was soon wholly exhausted. Since then nothing has appeared on the subject except the brief tabulations found in various reference books, and no attempt has been made to cover the whole subject.

It is needless to state that the growth of chemical science since the publication of Professor Storer's book has been so enormous that that work has lost, at least to a great extent, the practical value it possessed thirty years ago. This growth has been indeed so great, and the data which have accumulated since 1860 so far surpass the earlier in volume, that a simple revision of Professor Storer's book was impracticable, and it therefore seemed best to start afresh.

With the facilities offered by the various scientific libraries at Harvard University, the Massachusetts Institute of Technology, and other libraries in Boston, it has been possible to collect nearly all the data relating to the subject. For the work before 1860 Professor Storer's work has been found invaluable.

The method pursued has been to form a preliminary list of compounds with more or less data by consulting the two most complete works on inorganic chemistry—Gmelin-Kraut's "Handbuch der anorganischen Chemie" and Graham-Otto-Michaelis's "Lehrbuch." These statements have been verified and elaborated by consulting the original memoirs in all the periodicals devoted to chemical literature which were obtainable. The "Jahresbericht der Chemie" also has been used extensively in tracing references, but the original memoirs have always been consulted and references given to them when possible.

It has been found impracticable to draw any distinction as to reliability between the various data given by different observers. It was manifestly impossible to attempt to verify experimentally the statements of those who have carried on the researches, for the most assiduous labour of many could only cover a small portion of the attested facts. Therefore, even when two statements are directly contradictory, both have been given with the authority for each. The only exception to this has been made when more recent discoveries have shown beyond any reasonable doubt the falsity of previous work. In this way some of the older manifestly inaccurate work has been omitted. In a majority of cases the more recent work may be considered to be the more accurate, but this is not the invariable rule. A Synchronistic Table of the more common periodicals is given in the

Appendix, whereby it is easy to determine the date of the publication of a research to which reference is made.

It may be objected by the practical chemist that most of the work previous to 1850 might well have been omitted, but a great deal of this work possesses at least a historical value, and often furnishes facts which have not since been verified. Much of the earlier work, when obviously of less importance, has been printed in smaller type.

The aim has been to include in this volume all analysed inorganic substances, that is, all substances which do not contain carbon, but exception has been made in the case of CO_2, CO, CS_2, the carbonates, cyanides, ferrocyanides, etc., which are here included.

The work has been brought up to March 1894, when this volume went to press, and the results of researches published since that time are not included in the present edition.

It is hoped that this book will fill to some extent the want that has been felt by chemists for a compilation of this nature. While it has been attempted to make the book as free from errors as possible, nevertheless it is naturally impossible to avoid many mistakes, and the compiler will be very grateful to those who may call his attention to any errors or omissions.

A. M. C.

CAMBRIDGE, MASS., *Aug.* 1895.

EXPLANATORY PREFACE

In order to reduce this volume to a convenient size the subject matter has been abbreviated and condensed as far as seemed compatible with clearness; but it has been the aim not to use any abbreviations which are not at once intelligible without consulting the explanatory table. The more common chemical formulæ have been universally used, thereby saving a large amount of space without detracting from ready intelligibility to chemists.

The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling-points; other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances.

In many cases no definite distinction can be drawn between the phenomena of solution and decomposition. At present the theory of solution is in a confused state, and until what really takes place when a substance dissolves is thoroughly understood no distinct line can be drawn. The whole subject is unsettled at the present time; for while many chemists believe in the so-called "dissociation" theory, yet the "hydrate" theory is not without its supporters. It is not my intention to discuss the theoretical side of the question, which has been so well treated in many recent works. It is, however, obvious that the phenomena are essentially different, when, for example, sodium carbonate is dissolved in water, in which case the original salt is deposited on evaporation, and when iron is dissolved in sulphuric acid, and the solution deposits a sulphate of iron. Yet it is still the custom to speak of iron as soluble in sulphuric acid, although it would be much more accurate to say that the sulphuric acid was decomposed by the iron. It has thus been found impracticable to draw a sharp line between solution and decomposition, and the term "soluble" has in general been used where a solution of some sort is formed by the action of the solvent.

The matter of alphabetical arrangement of chemical compounds, in the present somewhat confused state of chemical nomenclature, has been a difficult question to decide. The plan followed has been practically that of the standard Dictionaries of Chemistry, whereby the compounds of metals with one of the non-metallic elements have been classified under the metals, while the salts of the other acids (the oxygen acids so-called and some few others) have been arranged alphabetically under the acids. Thus barium chloride is found under barium, while barium chlorate is found under chloric acid. No exception has been made in the case of the rare metals, as is usually the custom in Dictionaries of Chemistry. Double salts are to be found under the word which comes first alphabetically; thus, "common alum," potassium aluminum sulphate, is found under aluminum sulphate as aluminum potassium sulphate (under sulphuric acid), but ammonia chrome alum is found under ammonium sulphate as ammonium chromium sulphate. In the same way the double sulphate and chromate of potassium is found under potassium chromate (chromic acid), and not under potassium sulphate (sulphuric acid). The double chloride of ammonium and magnesium is found under ammonium chloride (ammonium), while the double chloride of potassium and magnesium is found under magnesium chloride (magnesium). An exception is made, however, in the case of double compounds of salts of oxygen acids with salts containing a single non-metallic element, in which case they are always found under the oxygen acid. Thus the double sulphate and chloride of lead, $PbSO_4$, $PbCl_2$, is found under lead sulphate (sulphuric acid), and not under lead chloride (lead).

The above method in some cases widely separates analogous compounds, but it was found to be the only practical way to a strictly alphabetical arrangement, which is so necessary in a book containing so many very short articles.

The ammonia addition-products furnished another difficulty. While their nature is more or less definitely understood in the cobalt, platinum, etc compounds, and a definite nomenclature is in general use, there is an absolute lack of anything of the kind in the less definite compounds. It is good usage to speak of cuprammonium compounds, but how shall we designate the analogous cadmium compounds? "Cadmammonium" has not yet received the sanction of chemists, and $AlCl_3$, NH_3 is a still worse case for naming. I have therefore, not attempted to name these compounds, but classified them al under the salts to which the ammonia is added, affixing the word ammonia thus: aluminum chloride ammonia, cadmium chloride ammonia, and also cupri chloride ammonia for the salt now almost universally known as cuprammonium chloride.

The ammonia compounds of cobalt, chromium, mercury, and the platinum metals are arranged alphabetically according to their universally accepted names, a list of which is given under each of those elements.

It has further been necessary to settle arbitrarily the question whethe a substance should be considered as a double salt or a salt of a compound acid containing one of the metals. For example, "fluosilicates" (or silic fluorides, as some may prefer) is the general name for the double fluorides of SiF_4 and a metal, but this unanimity in usage gradually disappears as the basic elements become more nearly alike, so that it is impossible to draw a line between such compounds and a compound such as the double chloride of magnesium and potassium, for which indeed the name "potassium chloromagnesate" has been proposed. The aim has been in all these cases to follow the best usage rather than make an absolutely homogeneous system of nomenclature out of the existing confusion.

In the matter of formulæ no attempt at uniformity has been made. Thus in the case above some chemists write the formula of the double chloride of magnesium and potassium as $KMgCl_3$, others as $KCl, MgCl_2$. The form here used has been in most cases that of the author from whom the data are taken.

The prefixes mono, di, tri, ortho, pyro, etc. have in general been disregarded in the alphabetical arrangement, and have been printed in italics. Exceptions to this have been made, however, in the cobalt, chromium, etc. ammonium compounds, and in a few others, as dithionic, perchloric, etc. acids. Cross references have been used, so as to prevent any confusion arising from lack of uniformity in this respect.

In the Appendix will be found formulæ and tables for the conversion of the degrees of various hydrometer scales into specific gravity, and a Synchronistic Table of the Periodicals to which references are most frequently made.

ABBREVIATIONS

abs.—absolute.
atmos.—atmosphere.
b.-pt.—boiling-point.
comp.—compound.
conc.—concentrated.
corr.—correction.
cryst.—crystallised.
decomp.—decompose, decomposes, decomposition, etc.
dil.—dilute.
insol.—insoluble.
M.—a univalent Metal.
Min.—Mineral.
mol.—molecule.
m.-pt.—melting-point.
ord.—ordinary.
ppt., pptd., etc.—precipitate, precipitated, etc.
pt.—part.
sat.—saturated.
sl.—slightly.
sol.—soluble.
sp. gr.—specific gravity.
supersat.—supersaturated.
t° = temperature in Centigrade degrees.
temp.—temperature.
vol.—volume.

ABBREVIATIONS OF REFERENCES

A.—Annalen der Pharmacie, edited by Liebig and others, 1832-39; continued as Annalen de Chemie und Pharmacie, 1840-73; continued as Justus Liebig's Annalen der Chemie, 1874-94+. 281 vols.

A. ch.—Annales de Chimie et de Physique. Paris. 1st series, 1789-1816, 96 vols.; 2nd series, 1817-40, 78 vols.; 3rd series, 1841-63, 69 vols.; 4th series, 1864-73, 30 vols.; 5th series, 1874-83, 30 vols.; 6th series, 1884-93, 30 vols; 7th series, 1893-94+, 3 vols.

Acta Lund.—Acta Universitatis Lundensis, or Lunds Universitets Års-skrift. Lund, 1864-94+. 27 vols.

Am. Chemist.—The American Chemist. New York, 1870-77. 7 vols.

Am. Ch. J.—The American Chemical Journal, edited by Remsen. Baltimore, 1879-94+. 16 vols.

Am. J. Sci.—American Journal of Science and Arts, edited by Silliman, Dana, and others. New Haven. 1st series, 1818-45, 50 vols.; 2nd series, 1846-70, 50 vols.; 3rd series, 1871-94+, 48 vols. Also numbered consecutively, 148 vols.

Analyst.—The Analyst. London, 1876-94+. 25 vols.

Ann. chim. farm.—Annali di chimica e di farmacologia. Milan, 1886-90. 5 vols.

Ann. des Mines.—*See* Ann. Min.

Ann. Min.—Annales des Mines. Paris. 1st series, 1817-26, 13 vols.; 2nd series, 1827-31, 10 vols.; 3rd series, 1832-41, 20 vols.; 4th series, 1842-51, 20 vols.; 5th series, 1852-61, 20 vols.; 6th series, 1862-71, 20 vols.; 7th series, 1872-81, 20 vols.; 8th series, 1882-91, 20 vols.; 9th series, 1892-94+, 6 vols.

Ann. Phil.—Annals of Philosophy. London. 1st series, 1813-1820, 16 vols.; new series, 1821-26, 12 vols.

Ann. Phys.—*See* Pogg. *and* W. Ann.

Arch. Pharm.—Archiv der Pharmacie, continued from Archiv des Apothekervereins in Norddeutschland, which forms the 1st series. 1st series, 1822-34, 50 vols.; 2nd series, 1835-72, 150 vols.; 3rd series, 1873-94+, 32 vols. Also numbered consecutively, which system is exclusively used after 3rd series, vol. 27 = vol. 227 (1889).

A. Suppl.—Annalen der Chemie und Pharmacie. Supplement-Bände. Vol. i. 1861; vol. ii. 1862-63; vol. iii. 1864-65; vol. iv. 1865-66; vol. v. 1867; vol. vi. 1868; vol. vii. 1870; vol. viii. 1872.

B.—Berichte der deutschen chemischen Gesellschaft. Berlin, 1868-94+. 27 vols.

B. A. B.—Sitzungsberichte der königlichen preussischen Akademie der Wissenschaften zu Berlin.

Belg. Acad. Bull.—Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique.

Berz. J. B.—Jahresbericht über die Fortschritte der physischen Wissenschaften, edited by Berzelius. 1822-47. 30 vols.

Br. Arch.—Archiv des Apothekervereins im nördlichen Teutschland, etc., edited by Brandes. 1st series, 1822-31, 39 vols., corresponds to 1st series of Arch. Pharm.

Bull. Ac. St. Pétersb.—Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg.

Bull. Soc.—Bulletin des Séances de la Société chimique de Paris. 2nd series, 1864-88, 50 vols.; 3rd series, 1889-94+, 12 vols.

Bull. Soc. ind. Mulhouse.—Bulletin de la Société industrielle de Mulhouse. 1828-49. 22 vols.

Bull. Soc. Min.—Bulletin de la Société française de Minéralogie. 1878-94. 17 vols.

C. C.—Chemisches Centralblatt, continued from Pharmaceutisches Centralblatt. 2nd series, 1856-69, 14 vols.; 3rd series, 1870-88, 19 vols.; 4th series, 1889-94+, 6 vols. Also numbered consecutively, 65 vols.

Chem. Ind.—Die Chemische Industrie, edited by Jacobsen. Berlin, 1878-94+. 17 vols.

Chem. Soc.—Journal of the Chemical Society of London. 1st series, 1849-62, 15 vols.; 2nd series, 1863-78, 17 vols.; new series, 1878-94+. The vols. are numbered consecutively from 1849. 1878=vol. 32. Total, 66 vols.

Chem.-tech. Centr.-Anz.—Chemisch-technischer Central-Anzeiger. 1883-94+. 12 vols.

Chem. Z.—*See* Ch. Z.

Ch. Gaz.—The Chemical Gazette. London, 1843-59. 17 vols.

Ch. Kal.—Chemiker Kalender, edited by Biedermann. 1880-94+. 15 vols.

Ch. Z.—Chemiker Zeitung. 1877-94+. 18 vols.

Cim.—Il Cimento. Turin, 1852-54. 6 vols.

C. N.—The Chemical News. London, 1860-94+. 70 vols.

Comm.—Commentar zur Pharmacopœa germanica by Hager. Berlin, 1883.

Compt. chim.—Comptes-rendus mensuels des Travaux chimiques, edited by Laurent and Gerhardt. 1845-51. 7 vols.

C. R.—Comptes-rendus hebdomadaires des Séances de l'Académie des Sciences. Paris, 1835-94+. 119 vols.

Crell. Ann.—Chemische Annalen für die Freunde der Naturlehre, etc., edited by Crell. 1784-1803. 40 vols.

Dansk. Vid. For.—Oversigt over det kgl. danske Videnskabernes Selskabs Forhandlinger. Copenhagen, 1847-92+. 20 vols.

Dingl.—Dingler's Polytechnisches Journal, edited by Dingler and others. 1820-94+. 294 vols.

Edinb. Trans.—Transactions of the Royal Society of Edinburgh. 1788-1894+. 35 vols.

Ed. J. Sci.—The Edinburgh Journal of Science. 1st series, 1824-29, 10 vols.; 2nd series, 1829-32, 6 vols. Continued as Phil. Mag.

Gazz. ch. it.—Gazzeta chimica italiana. Palermo, 1871-94+. 24 vols.

Gilb. Ann.—Annalen der Physik, edited by Gilbert. 1st series, 1799-1808, 30 vols.; 2nd series, 1809-18, 30 vols.; 3rd series, 1819-24, 26 vols. Also numbered consecutively, 76 vols. Continued as Pogg.

Gm.-K.—Gmelin-Kraut's Handbuch der anorganischen Chemie, 6te Auflage. 1877-94+.

Gr.-Ot.—Graham-Otto's ausführliches Lehrbuch der anorganischen Chemie, 5te Auflage, by Michaelis. 1878-89.

Jahrb. d. Pharm.—Jahresbericht der Pharmacie. 1866-94+. 28 vols.

J. Am. Chem. Soc.—Journal of the American Chemical Society. New York, 1876-94+. 17 vols.

J. Anal. Appl. Ch.—The Journal of Analytical and Applied Chemistry, edited by Hart. 1887-93. 7 vols.

J. B.—Jahresbericht über die Fortschritte der Chemie, u.s.w. 1847-90+. 43 vols.

J. Chim. méd.—Journal de Chimie médicale, de Pharmacie, et de Toxicologie. 1st series, 1825-34, 10 vols.; 2nd series, 1835-44, 10 vols.; 3rd series, 1845-54, 10 vols.; 4th series, 1855-64, 10 vols.; 5th series, 1865-76, 12 vols.

Jena. Zeit.—Jenaische Zeitschrift für Medicin und Naturwissenschaften. 1865-94+. 22 vols.

J. Pharm.—Journal de Pharmacie et de Chimie. Paris. 2nd series, 1815-41, 27 vols.; 3rd series, 1842-64, 46 vols.; 4th series, 1865-79, 30 vols.; 5th series, 1879-94+. 30 vols.

J. Phys.—Journal der Physik, edited by Gren. 1790-98. 12 vols. Continued as Gilb. Ann.

J. pr.—Journal für praktische Chemie, edited by Erdmann, Kolbe, and v. Meyer. Leipzig. 1st series, 1834-69, 108 vols.; 2nd series, 1870-94+, 50 vols.

J. Russ. Soc.—Journal of the Russian Chemical Society. St. Petersburg, 1869-94+. 26 vols.

J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry. London, 1882-94+. 13 vols.

J. S. C. I.—*See* above.

Kastn. Arch.—Archiv für die gesammte Naturlehre, edited by Kastner. Nuremberg, 1824-35. 25 vols.

Listy Chemické.—Listy Chemické, edited by Preis and others. Prague, 1875-94+. 19 vols.

Lond. R. Soc. Proc.—*See* Roy. Soc. Proc.

Lund. Univ. Arsk.—Lunds Universitets Års-skrift. Lund, 1864-94+. 27 vols.

M.—Monatshefte für Chemie und verwandter Theile der anderer Wissenschaften. Vienna, 1880-94+. 15 vols.

M. A. B.—Sitzungsberichte der mathematisch-physikalischen Classe der kgl. bayerischen Akademie der Wissenschaften zu München. 1871-94+. 24 vols.

Mag. Pharm.—Magazin der Pharmacie. 1823-31. 36 vols.

Mém. Acad. St. Pétersb.—Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg.

M. Ch.—*See* M.

Miner. Jahrb.—Neues Jahrbuch für Mineralogie, etc. 1833-73. 40 vols.

Monit. Scient.—Le Moniteur Scientifique, edited by Quesnesville. Paris, 1857-94+. 36 vols.

N. Arch. Sc. ph. nat.—Nouvelles Archives des Sciences physiques et naturelles. Geneva.

N. Cim.—Il nuovo Cimento. Pisa, 1855-61. 14 vols.

N. Edinb. Phil. J.—New Edinburgh Philosophical Journal. 1819-64. 90 vols.

N. Jahrb. Pharm.—Neues Jahrbuch der Pharmacie. 1796-1840. 42 vols.

N. J. Pharm.—Neues Journal der Pharmacie für Aerzte, etc., edited by Trommsdorff. 1817-34. 27 vols.

N. Rep. Pharm.—Neues Repertorium für Pharmacie. 1852-76. 25 vols.

Pharm. Centralbl.—Pharmaceutisches Centralblatt. 1830-49. 20 vols. Continued as C. C.

Pharm. Era.—Pharmaceutical Era.

Pharm. J. Trans.—Pharmaceutical Journal and Transactions. New series, 1870-94+. 24 vols.

Pharm. Vierteljb.—Pharmaceutische Vierteljahresberichte.

Pharm. Ztg.—Pharmaceutische Zeitung.

Phil. Mag.—The Philosophical Magazine. London. 1st series, 1814-26, 26 vols.; 2nd series, 1827-32, 11 vols.; 3rd series, 1832-50, 37 vols.; 4th series, 1851-75, 50 vols.; 5th series, 1876-94+, 38 vols.

Phil. Mag. Ann.—The Philosophical Magazine and Annals of Chemistry, etc. Corresponds to Phil. Mag. 2nd series.

Phil. Trans.—The Philosophical Transactions of the Royal Society of London. 1665-1894+.

Pogg.—Annalen der Physik und Chemie, edited by Poggendorf. 1st series, 1824-43, 60 vols.; 2nd series, 1844-53, 30 vols.; 3rd series, 1854-63, 30 vols.; 4th series, 1864-73, 30 vols.; 5th series, 1874-77, 10 vols. Continued as W. Ann.

Polyt. Centralbl.—Polytechnisches Centralblatt. 1st series, 1835-46, 12 vols.; 2nd series, 1847-73, 30 vols.

Proc. Am. A. A. S.—Proceedings of the American Association for the Advancement of Science.

Proc. Am. Acad.—Proceedings of the American Academy of Arts and Sciences. Boston, 1846-94+. 29 vols.

Proc. Soc. Manchester.—Proceedings of the Literary and Philosophical Society of Manchester.

Proc. Roy. Soc.—*See* Roy. Soc. Proc.

Q. J. Sci.—Quarterly Journal of Science. London, 1816-26. 22 vols.

Real. Ac. Linc.—Atti di Reale Accademia dei Lincei. Rome.

Rep. anal. Ch.—Repertorium der analytischen Chemie. 1881-87. 7 vols.

Rep. Brit. Assn. Adv. Sci.—Reports of the Meetings of the British Association for the Advancement of Science. 1831-94+. 64 vols.

Repert.—*See* Rep. Pharm.

Répert. chim. appl.—Répertoire de Chimie pure et appliquée. Paris, 1858-63. 9 vols.

Rep. Pharm.—Repertorium für die Pharmacie, edited by Buchner. 1st series, 1815-34, 50 vols.; 2nd series, 1835-48, 50 vols.; 3rd series, 1849-51, 10 vols. Continued as N. Rep. Pharm.

Roy. Soc. Proc.—Proceedings of the Royal Society of London. 1832-94+. 54 vols.

Roy. Soc. Trans.—Abstracts of Philosophical Transactions of the Royal Society of London. 1832-54. 6 vols. Continued with Roy. Soc. Proc.

R. t. c.—Recueil des Travaux chimiques des Pays-Bas. Leiden, 1882-94+. 13 vols.

Russ. Zeit. Pharm.—Pharmaceutische Zeitschrift für Russland.

Scheik. Verhandel.—Scheikundige Verhandelingen en Onderzoekingen, edited by Mulder. Rotterdam, 1857-64. 3 vols.

Scher. J.—Allgemeines Journal der Chemie, edited by Scherer. 1798-1810. 17 vols. Continued as Schw. J.

Schw. J.—Journal für Chemie und Physik, edited by Schweigger. 1st series, 1811-20, 30 vols.; 2nd series, 1821-30, 30 vols.; 3rd series, 1831-33, 9 vols. Continued as J. pr.

Sill. Am. J.—American Journal of Science, edited by Silliman, etc. *See* Am. J. Sci.

Sitzungsb. böhms. Gesell.—Sitzungsberichte der königlichen böhmschen Gesellschaft der Wissenschaften in Prag. 1859-94+.

Storer's Dict.—First Outlines of a Dictionary of Solubilities of Chemical Substances, by F. H. Storer. Boston, 1864.

Sv. V. A. F.—Öfversigt af kongl. Svenska Vetenskaps-Akademien Förhandlingar. Stockholm, 1844-94+. 51 vols.

Sv. V. A. H.—Kongliga Svenska Vetenskaps-Akademiens Handlingar. Stockholm, 1856-94+. 26 vols.

Sv. V. A. H. Bih.—Bihang till kongl. Svenska Vetenskaps-Akademiens Handlingar. Stockholm, 1872-94+. 18 vols.

Techn. J. B.—Jahresbericht über die Fortschritte der chemischen Technologie, edited by Wagner, Fischer, etc. 1st series, 1855-69, 15 vols.; 2nd series, "N.F.," 1870-94+, 25 vols. Also numbered consecutively, 40 vols.

W. A. B.—Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften zu Wien. 1848-94+. 104 vols.

W. Ann.—Annalen der Physik und Chemie, edited by Wiedemann. Continuation of Pogg. 1877-94+. 52 vols.

Z. anal.—Zeitschrift für analytische Chemie, edited by Fresenius. Wiesbaden, 1862-94+. 39 vols.

Z. anorg.—Zeitschrift für anorganische Chemie, edited by Krüss. 1892-94+. 6 vols.

Zeit. angew. Ch.—Zeitschrift für angewandte Chemie. Berlin, 1887-94+. 8 vols.

Zeit. Chem.—Zeitschrift für Chemie und Pharmacie. 1st series, 1858-64, 6 vols.; 2nd series, "N.F.," 1865-71, 7 vols.

Zeit. d. allgem. öster. Apothekerv.—Zeitschrift des allgemeinen österreichischen Apothekervereins.

Zeit. ges. Nat.—Zeitschrift für die gesammten Naturwissenschaften.

Zeit. Kryst.—Zeitschrift für Krystallographie und Mineralogie. 1877-94+. 24 vols.

Zeit. Pharm.—*See* Russ. Zeit. Pharm.

Z. phys. Ch.—Zeitschrift für physikalische Chemie, edited by Ostwald and van 't Hoff. 1887-94+. 14 vols.

DICTIONARY

OF

CHEMICAL SOLUBILITIES

INORGANIC

Air, Atmospheric.

See also **Nitrogen** *and* **Oxygen.**

100 vols. H_2O at 15° and 760 mm. absorb about 5 vols. atmospheric air. (Saussure.)

1 vol. H_2O at t° and 760 mm. pressure absorbs V vols. atmospheric air reduced to 760 mm. and 0°.

t°	V	t°	V	t°	V
0	0·02471	7	0·02080	14	0·01822
1	0·02406	8	0·02034	15	0·01795
2	0·02345	9	0·01992	16	0·01771
3	0·02287	10	0·01953	17	0·01750
4	0·02237	11	0·01916	18	0·01732
5	0·02179	12	0·01882	19	0·01717
6	0·02128	13	0·01851	20	0·01701

(Bunsen's Gasometry.)

1 l. H_2O absorbs ccm. N and O from air at t° and 760 mm. pressure.

t°	ccm. N	ccm. O	ccm. N+O
0	16·09	8·62	24·71
5	14·18	7·60	21·78
10	12·70	6·79	19·49
15	11·67	6·25	17·92
20	11·08	5·93	17·01

(Bunsen, Gasometr. Methoden, 2te Aufl. 209, 220.)

1 l. H_2O absorbs ccm. N and O from air at t° and 760 mm. pressure (dry).

t°	ccm. N	ccm. O	N+O	% O
10	15·47	7·87	23·34	33·74
15	13·83	7·09	20·92	33·86
20	12·76	6·44	19·20	33·55
25	11·78	5·91	17·69	33·40

(Roscoe and Lunt, Chem. Soc **55.** 568.)

1 l. H_2O absorbs ccm. N and O from air at t° and 760 mm.

t°	ccm. N	ccm. O	% O
0	19·53	10·01	33·88
6·0	16·34	8·28	33·60
6·32	16·60	8·39	33·35
9·18	15·58	7·90	33·60
13·70	14·16	7·14	33·51
14·10	14·16	7·05	33·24

(Pettersson and Sondén, B. **22.** 1439.)

1 l. H_2O absorbs ccm. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	ccm. N	t°	ccm. N	t°	ccm. N
0	19·14	10	15·14	20	12·63
2	18·20	12	14·53	22	12·27
4	17·34	14	13·98	24	11·95
6	16·54	16	13·48	25	11·81
8	15·81	18	13·03	...	...

(Hamberg, J. pr. (2) **33.** 447.)

1 l. H_2O absorbs ccm. N from air at t° and 760 mm. pressure.

t°	ccm. N	t°	ccm. N	t°	ccm. N
0	19·29	10	15·36	20	12·80
5	17·09	15	13·95	25	11·81

(Dittmar, Challenger Expedition, vol. **1.** pt. 1.)

1 l. H_2O sat. with air at t° and 760 mm. contains ccm. O (red. to 0° and 760 mm.).

t°	ccm. O	t°	ccm. O	t°	ccm. O
0	10·187	5	8·907	10	7·873
1	9·910	6	8·682	11	7·692
2	9·643	7	8·467	12	7·518
3	9·387	8	8·260	13	7·352
4	9·142	9	8·063	14	7·192

1 l. H_2O sat. etc.—*Continued.*

t°	ccm. O	t°	ccm. O	t°	ccm. O
15	7·038	21	6·233	27	5·564
16	6·891	22	6·114	28	5·460
17	6·730	23	5·999	29	5·357
18	6·614	24	5·886	30	5·255
19	6·482	25	5·776	...	...
20	6·356	26	5·669	...	...

(Winkler, B. **22**. 1773.)

1 vol. H_2O absorbs 0·01748 vol. air at 24·05° and 760 mm. pressure. (Winkler, B. **21**. 2851.)

Composition of the absorbed air between 0° and 24° is 34·91 % O and 65·09 % N (Bunsen); between 15° and 16°, 32·17 % O and 67·83 % N (König and Kranch, Z. anal. **19**. 259); 32 % O and 68 % N (Regnault); at 0°, 35·1 % O; 10°, 34·8 % O; 20°, 34·3 % O; 25°, 33·7 % O (Winkler, B. **21**. 2843). *See also* Roscoe and Lunt, and Pettersson and Sondén, page 1.

Sea-water absorbs less O and N from air than pure H_2O, but the ratio between O and N remains constant. In sea-water sat. with air at 6·22° the oxygen was 33·50 % of the total gas absorbed. (Pettersson and Sondén.)

1 l. sea-water absorbs ccm. N and O from air at t° and 760 mm. pressure.

t°	ccm. N	ccm. O	N+O	% O
0	14·41	7·77	22·18	35·03
5	13·22	6·93	20·15	34·39
10	12·08	6·29	18·37	34·24
15	11·01	5·70	16·71	34·11

(Tornoë, Norwegian North Atlantic Exped. Chem. 18.)

1 l. sea water absorbs ccm. N from air at t° and 760 mm.

t°	ccm. N	t°	ccm. N	t°	ccm. N
0	15·60	10	12·47	20	10·41
5	13·86	15	11·34	25	9·62

(Dittmar.)

1 l. sea-water absorbs ccm. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	ccm. N	t°	ccm. N	t°	ccm. N
0	14·85	10	12·06	20	10·25
2	14·20	12	11·62	22	9·98
4	13·60	14	11·23	24	9·73
6	13·04	16	10·87	25	9·62
8	12·53	18	10·54	...	...

(Hamberg.)

Absolute alcohol absorbs 0·11 vol. gas from air, $\frac{1}{3}$ of which is O and $\frac{2}{3}$, N. On mixing with an equal vol. H_2O, $\frac{2}{3}$ of the dissolved gas is given off. (Döbereiner.)

100 vols. alcohol (95·1 %) absorb 14·1 vols. air. (Robinet, C. R. **58**. 608.)

100 vols.	petroleum	absorb	6·8	vols.	air.
,, ,,	oil of lavender	,,	6·89	,,	,,
,, ,,	benzene	,,	14·0	,,	,,
,, ,,	oil of turpentine	,,	24·18	,,	,,

(Robinet, *l.c.*)

Alum, Ammonia.

See **Sulphate, aluminum ammonium.**

Alum, Chrome.

See **Sulphate, aluminum chromium.**

Alum, Iron.

See **Sulphate, aluminum ferric.**

Alum, Potash.

See **Sulphate, aluminum potassium.**

Alumina.

See **Aluminum oxide.**

Aluminic acid, $H_2Al_2O_4 = Al_2O_3, H_2O$.

Aluminum hydroxide possesses acid properties, and salts corresponding to an acid of the above formula exist.

See **Aluminum hydroxide.**

Aluminates.

All aluminates are insol. in H_2O except those of K and Na (Fremy) and Ba (Beckmann, J. pr. (2) **26**. 385).

Barium aluminate, $BaAl_2O_4 + 4H_2O$.

Sol. in 10 pts. H_2O; can be recryst. from alcohol. (Deville, J. pr. **87**. 299.)

$+7H_2O$. Sl. sol. in cold, not completely sol. in hot H_2O. Sol. in cold dil. HCl+Aq. (Beckmann, J. pr. (2) **26**. 385.)

$Ba_2Al_2O_5 + 5H_2O$. Sol. in 20 pts. H_2O by boiling. (Beckmann, B. **14**. 2151.)

Insol. in alcohol.

$Ba_3Al_2O_6 + 7\text{-}11H_2O$. Sol. in 15 pts. H_2O with decomp. into $Ba_2Al_2O_5 + 5H_2O$; insol. in alcohol. (Beckmann.)

Barium aluminate bromide, $BaAl_2O_4, BaBr_2 + 11H_2O$.

Sol. in H_2O. (Beckmann, J. pr. (2) **26**. 385, 474.)

Barium aluminate chloride, $BaAl_2O_4, 3BaCl_2 + 6H_2O$.

Sol. in H_2O. (Beckmann, *l.c.*)

$BaAl_2O_4, BaCl_2 + 11H_2O$. Sol. in H_2O. (Beckmann, *l.c.*)

Barium aluminate iodide, $BaAl_2O_4, BaI_2$.

Sol. in H_2O. (Beckmann, *l.c.*)

Calcium aluminate, $3CaO, Al_2O_3$.

Insol. in H_2O; not decomp. by KOH+Aq; sol. in acids. (Tissier, C. R. **48**. 627.)

$3CaO, 2Al_2O_3$. Insol. in H_2O; only sl. sol. in acids.

$CaAl_2O_4$. Insol. in H_2O.

Cobalt aluminate.

"*Thenard's* or *Leithner's blue.*" Insol. in H_2O.

$CoAl_2O_4$. Insol. in H_2O and acids. (Ebelmen.)

Cobalt magnesium aluminate, $[MgCo]Al_2O_4$.

"*Spinel blue.*" Insol. in H_2O or HCl+Aq. (Ebelmen.)

Glucinum aluminate, $GlAl_2O_4$.

Min. *Chrysoberyll.* Not attacked by acids, but decomp. by KOH+Aq.

Ferrous aluminate, $FeAl_2O_4$.

Min. *Hercynite.* Not attacked by acids.

Magnesium aluminate, $MgAl_2O_4$.

Min. *Spinel.* Insol. in H_2O.

Insol. in HNO_3+Aq; very sl. sol. in HCl+Aq; partly sol. in H_2SO_4 at boiling temp. (Abich, Pogg. **23**. 316.)

Sol. by standing 2 hours at 210° with a mixture of 3 pts. H_2SO_4 and 1 pt. H_2O, or by boiling with this mixture together with HF. (Mitscherlich, J. pr. **81**. 108.)

Manganous aluminate.

Insol. in H_2O and acids. (Ebelmen, A. ch. (3) **22**. 225.)

Nickel aluminate.

Insol. in H_2O.

Potassium aluminate, $K_2Al_2O_4+3H_2O$.

Decomp. by dissolving in pure H_2O with separation of Al_2O_3. (Fremy, A. ch. (3). **12**. 362.) Can be recrystallised from water containing a little alkali, without decomposition. (Fremy.)

Insol. in alcohol.

Sodium aluminate, $Na_2Al_2O_4$.

Easily and completely sol. in cold H_2O. (Schaffgotsch, Pogg. **43**. 117.)

$Na_6Al_2O_6$. Miscible with hot H_2O, and as sol. as NaOH in cold H_2O. Insol. in alcohol, but decomp. thereby. (Tissier, C. R. **43**. 102.)

Zinc aluminate, $ZnAl_2O_4$.

Insol. in acids or alkalies.

Min. *Gahnite* (*Automolite*).

$+xH_2O$. Sol. in KOH, and NH_4OH+Aq. (Berzelius.)

Aluminomolybdic acid.

M. aluminomolybdates.

See **Molybdates, aluminum M.**

Aluminum, Al.

Not attacked by cold H_2O, but slowly oxidised at 100°. Easily sol. in dil. or conc. HCl+Aq, whether hot or cold; also in HBr, HI, or HF+Aq. Insol. in dil. H_2SO_4+Aq (de la Rive); sl. attacked by cold, easily by hot conc. H_2SO_4. Not attacked by HNO_3+Aq even when conc. and boiling (Wöhler); easily sol. in dil. H_2SO_4, or HNO_3+Aq in vacuo (Weeren, B. **24**. 1798); slowly sol. in 27 % HNO_3+Aq, 100 ccm. HNO_3+Aq requiring 2 months to dissolve 2 g. Al (Montemartini, Gazz. ch. it. **22**. 397); very sl. sol. in most organic acids, but solubility is increased by presence of NaCl.

Very easily sol. in conc. or dil. KOH, or NaOH+Aq. Slowly attacked by NH_4OH+Aq (Wöhler); sol. in BaO_2H_2+Aq (Beckmann, J. pr. (2) **26**. 385); slowly sol. in CaO_2H_2+Aq.

Sl. attacked by sulphates, or nitrates+Aq, but all chlorides, bromides, and iodides, except those of the alkalies and alkaline earths, even $AlCl_3$+Aq, dissolve the metal. Insol. in alum, or in NaCl+Aq, but sol. in alum+NaCl+Aq (Tissier, C. R. **41**. 362); sol. in NaCl+Aq (Deville, A. ch. (3) **43**. 14); sol. in neutral $FeCl_3$+Aq in vacuo. (Weeren, *l.c.*)

Violently attacked by $CuCl_2$+Aq. (Tommasi, Bull. Soc. (2) **37**. 443.)

Attacked by $POCl_3$ at 100°. (Renitzer, B. **13**. 845.)

Not attacked by sugar+Aq. (Klein, C. R. **102**. 1170.)

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H_2O, wine, beer, coffee, milk, oil, butter, fats, etc. Vinegar dissolves 0·349 g. from a sq. decimetre in 4 months, and 5 % NaCl+Aq, only 0·045 g. in the same time. (Balland, C. R. **114**. 1536.)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight. Hard or soft water, whether cold or hot, showed no action in 8 days; 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids. 4 % and 10 % acetic acid dissolved only 0·4 mg. of Al, while 10 % acetic acid dissolved 2·1 mg. from a roughened piece of Al foil in 8 days. 1 % soda solution dissolved 15 mg. in 8 days. (Rupp, Dingl. **283**. 119.)

Similar results were obtained by Arche. (Dingl. **284**. 255.)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree. The following losses in weight in mg. by the action of the given liquids on 100 sq. centimetres sheet aluminum for 6 days were obtained:

Liquids.	Loss in mg.
Claret	2·84
Hock	3·27
Brandy	1·08
5 % alcohol	0·61
5 % tartaric acid+Aq	1·69
1 % ,, ,,	2·58
5 % acetic acid+Aq	3·58
1 % ,, ,,	4·38
5 % citric acid+Aq	2·15
1 % ,, ,,	1·90
5 % lactic acid+Aq	4·77
5 % butyric acid+Aq	1·31
Coffee	0·50
Tea	0
Beer	0
4 % boric acid+Aq	1·77
5 % carbolic acid+Aq	0·23
1 % ,, ,,	0·49
¼ % salicylic acid+Aq	6·35

(Lunge, C.N. **65**. 110.)

Aluminum arsenide.

Decomp. by H_2O with evolution of AsH_3. (Wöhler, Pogg. **11.** 160.)

Aluminum boride, Al_2B_4.

Very slowly sol. in hot conc. $HCl+Aq$, and hot $NaOH+Aq$, but easily in moderately strong warm HNO_3+Aq. (Hampe, A. **183.** 75.)

Al_2B_{24}. Not attacked by HCl, or $KOH+Aq$. Scarcely attacked by boiling H_2SO_4. Hot conc. HNO_3+Aq dissolves gradually but completely. (Hampe, *l. c.*)

Aluminum borocarbide, $Al_3C_2B_{48}$.

Insol. in H_2O, $HCl+Aq$, H_2SO_4+Aq, or $KOH+Aq$; slowly sol. in hot conc. HNO_3+Aq. (Hampe, *l.c.*)

Aluminum bromide, $AlBr_3$.

Anhydrous. Dissolved by H_2O with great violence and evolution of much heat. Very sol. in alcohol. More sol. in CS_2 than AlI_3. (Weber, Pogg. **103.** 264.)

$+6H_2O$. Very sol. in H_2O.

Aluminum potassium bromide, $AlBr_3$, KBr.

Sol. in H_2O. (Weber, Pogg. **103.** 267.)

Aluminum bromide ammonia, $AlBr_3$, xNH_3.

Decomp. by H_2O. (Weber, Pogg. **103.** 267.)

Aluminum chloride, $AlCl_3$.

Anhydrous. Very deliquescent. Sol. in H_2O with a hissing noise and evolution of heat. Solution of $AlCl_3$ in H_2O loses HCl on evaporation, and $AlCl_3$ is finally wholly converted into Al_2O_3.

Sol. in 1·432 pts. H_2O at 15°. (Gerlach.)

$AlCl_3+Aq$ containing 19·15 % $AlCl_3$ boils at 103·4°; $AlCl_3+Aq$ containing 38·3 % $AlCl_3$ boils at 112·8°. (Gerlach.)

Sp. gr. of $AlCl_3+Aq$ at 15°.

% $AlCl_3$.	Sp. gr.	% $AlCl_3$.	Sp. gr.
1	1·0072	22	1·1709
2	1·0144	23	1·1795
3	1·0216	24	1·1968
4	1·0289	25	1·2058
5	1·0361	26	1·2149
6	1·0435	27	1·2241
7	1·0510	28	1·2331
8	1·0585	29	1·2331
9	1·0659	30	1·2422
10	1·0734	31	1·2518
11	1·0812	32	1·2615
12	1·0890	33	1·2711
13	1·0968	34	1·2808
14	1·1047	35	1·2905
15	1·1125	36	1·3007
16	1·1207	37	1·3109
17	1·1290	38	1·3211
18	1·1372	39	1·3313
19	1·1455	40	1·3415
20	1·1537	41	1·3522
21	1·1632		

(Gerlach, Z. anal. **8.** 281.)

Sol. in 1 pt. strong alcohol at 12·5° (Wenzel); easily sol. in ether; sl. sol. in CS_2; insol. in ligroine or benzene.

$+6H_2O$. Very deliquescent; very sol. in H_2O; sol. in 0·25 pt. H_2O. (Thomson.)

Sol. in 2 pts. abs. alcohol at ordinary temp., and 1·5 pts. at b.-pt. (Thomson.)

Aluminum nitrosyl chloride, $AlCl_3$, NOCl.

Deliquescent, and decomp. by H_2O. (Weber, Pogg, **118.** 471.)

Aluminum palladium chloride, $AlCl_3$, $PdCl_2+10H_2O$.

See **Chloropalladite, aluminum.**

Aluminum phosphorus *penta***chloride,** $AlCl_3$, PCl_5.

Decomp. violently by H_2O. (Baudrimont.)

Aluminum phosphoryl chloride, $AlCl_3$, $POCl_3$.

Deliquescent. Sol. in H_2O with decomp. Sol. in warm $POCl_3$, from which it separates on cooling. (Casselmann, A. **98.** 220.)

Aluminum platinum chloride, $AlCl_3$, $PtCl_2+15H_2O$.

See **Chloroplatinite, aluminum.**

Aluminum potassium chloride, $AlCl_3$, KCl.

Slowly deliquescent. Sol. in H_2O with evolution of heat and decomp. (Degen, A. **18.** 332.)

Aluminum selenium chloride, $2AlCl_3$, $SeCl_4$.

Sol. in H_2O with evolution of heat and separation of traces of selenium. (Weber, Pogg. **104.** 427.)

Aluminum sodium chloride, $AlCl_3$, NaCl.

Much less deliquescent than $AlCl_3$. Sol. in H_2O with evolution of heat. Upon evaporating, NaCl crystallises out. (Wöhler.)

Aluminum sulphur chloride, $2AlCl_3$, SCl_4.

Decomp. by H_2O with evolution of much heat and separation of some sulphur. (Weber, Pogg, **104.** 421.)

Aluminum tellurium chloride, $2AlCl_3$, $TeCl_4$.

Very sol. in dil. H_2SO_4+Aq. (Weber, J. pr. **76.** 313.)

Aluminum chloride ammonia, $AlCl_3$, NH_3.

Sol. in H_2O. (Rose, Pogg. **24.** 248.)

$AlCl_3$, $3NH_3$. Decomp. by H_2O.

Aluminum chloride phosphine, $3AlCl_3$, PH_3.

Decomp. by H_2O or NH_4OH+Aq. (Rose, Pogg. **24.** 295.)

Aluminum chloride hydrogen sulphide.

Deliquescent. Decomp. by H_2O or NH_4OH+Aq. (Wöhler.)

Aluminum chloride sulphur *di***oxide,** $AlCl_3$, SO_2.

Decomp. by H_2O, alcohol, or benzene. (Adrianowski, B. **12.** 688.)

Aluminum fluoride, AlF_3.

Anhydrous. Not attacked by H_2O or acids, and only very slightly by boiling conc. H_2SO_4.

Insol. in boiling KOH + Aq. (Deville, C. R. **42.** 49.)

+$7H_2O$. Sol. in H_2O. (Deville, A. ch. (3) **61.** 329.)

Min. *Fluellite.*

Aluminum hydrogen fluoride, $3AlF_3$, $2HF+5H_2O$.

Sol. in H_2O; precipitated by alcohol. (Deville.)

$2AlF_3$, $HF+5H_2O$. (Deville, A. ch. (3) **61.** 329.)

Aluminum ammonium fluoride, AlF_3, NH_4F.

Somewhat sol. in H_2O; insol. in H_2O containing NH_4OH or NH_4F. (Berzelius, Pogg. **1.** 45.)

AlF_3, $3NH_4F$. Nearly insol. in H_2O; easily sol. in dil. acids. (Petersen, J. pr. (2) **40.** 35.)

Quite easily sol. in H_2O, but insol. in NH_4F + Aq. (Helmholt, Z. anorg. **3.** 129.)

Aluminum barium fluoride.

Apparently not obtained in pure state. (Röder.)

Aluminum calcium sodium fluoride, AlF_3, CaF_2, $NaF+H_2O$.

Min. *Pachnolite.*

Aluminum cupric fluoride, $2AlF_3$, CuF_2.

Very slowly but completely sol. in H_2O. (Berzelius.)

Aluminum lithium fluoride.

Insol. in H_2O. (Berzelius.)

Aluminum magnesium fluoride.

$2AlF_3$, MgF_2 (?). (Röder.)

Aluminum nickel fluoride.

Sol. in H_2O. (Berzelius.)

Aluminum potassium fluoride, AlF_3, $3KF$.

Very sl. sol. in acid solutions, and still less in H_2O. (Gay-Lussac and Thénard.)

AlF_3, $2KF$. As above.

Aluminum sodium fluoride.

$2AlF_3$, $3NaF$. Min. *Chiolite.*

AlF_3, $2NaF$. Min. *Chodneffite.*

AlF_3, $3NaF$. Min. *Cryolite.* Sl. sol. in H_2O. Insol. in HCl + Aq. Decomp. by H_2SO_4, or by boiling with NaOH + Aq.

Aluminum strontium fluoride.

As the Ba salt. (Röder.)

Aluminum zinc fluoride, $2AlF_3$, ZnF_2.

Slowly but completely sol. in H_2O. (Berzelius.)

Aluminum hydroxide, $Al_2O_3,H_2O=Al_2O_2(OH)_2$.

Dehydrated by conc. acids, without dissolving. (Becquerel, C. R., **67.** 108.)

Min. *Diaspore.* Insol. in HCl + Aq, and not attacked by boiling conc. H_2SO_4, unless it has been ignited.

$Al_2O_3,2H_2O=Al_2O(OH)_4$. Pptd. Al hydroxide, when boiled twenty hours with H_2O is insol. in acids and alkalies, and has the above composition. (St. Gilles, A. ch. (3) **46.** 57.)

Min. *Bauxite.*

Soluble modifications — (a) *Meta-aluminum hydroxide. From basic Al acetate.* Sol. in H_2O and more readily in $HC_2H_3O_2$. The aqueous solution is coagulated by traces of alkalies, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt. H_2SO_4 in 1000 pts. H_2O, added to 7000 pts. of above solution containing 20 pts. Al_2O_3, converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, comenic, and hemipinic acids act in the same way. HCl and HNO_3 have far less action, 600 mols. being necessary to produce the same effect as 1 mol. H_2SO_4, while acetic, formic, boric, arsenious, pyromeconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt. KOH in 1000 pts. H_2O coagulates 9000 pts. of the solution. NaOH, NH_4OH, and $Ca(OH)_2$ have the same effect.

The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt. is redissolved when treated with H_2O. Nitrates and chlorides coagulate with difficulty; Na_2SO_4, $MgSO_4$, and $CaSO_4$ + Aq, however, have as strong an action as a liquid containing the same amount of H_2SO_4. A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt. formed by acids is not sol. in an excess of the acid, but by the long continued action of conc. H_2SO_4, especially if hot, the ppt. is dissolved; boiling conc. HCl + Aq also dissolves it, but less readily than H_2SO_4. The ppt. is sol. in boiling conc. KOH + Aq. The residue, when the solution is evaporated at 100°, has composition Al_2O_3, $2H_2O$, and is insol. in acids. (Crum, Chem. Soc. **6.** 225.)

(b) *By Dialysis.* Sol. in H_2O, from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially K_2SO_4), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0·5% Al_2O_3 or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to ½ its vol., and even very dil. solutions gelatinise spontaneously in a few days. The solution is not coagulated by alcohol or sugar. (Graham, A. **121.** 41.)

$Al_2O_3,3H_2O=Al_2O_6H_6$. *Crystallised.* Difficultly sol. in acids and alkalies. (Cossa, N. Cim. (2) **3.** 228.) Insol. in boiling HCl + Aq. (Wöhler, A. **113.** 249.) Sl. sol. in KOH + Aq; nearly insol. in cold H_2SO_4, HCl, HNO_3 + Aq; very slowly sol. in hot HCl + Aq, more readily in hot H_2SO_4. (v. Bonsdorff, Pogg. **27.** 275.)

Min. *Gibbsite.* Sol. in HCl + Aq, and dil. H_2SO_4 + Aq. Readily sol. in conc. KOH, and NaOH + Aq.

Precipitated. Completely insol. in H_2O or H_2CO_3 + Aq. Easily sol. in acids when freshly pptd., but solubility diminishes on standing.

Easily sol. in KOH or NaOH + Aq. (Sonnenschein.)

Sl. sol. in NH_4OH + Aq when freshly pptd., but presence of NH_4 salts diminish its solubility, and it separates out completely after long standing. (Fresenius.)

Somewhat sol. in NH_4OH+Aq, the more readily the larger the vol. of H_2O. Somewhat sol. in $(NH_4)_2CO_3$+Aq, but less than in NH_4OH+Aq. Sl. sol. in dil. NH_4Cl+Aq, unless that salt be in large excess. It is finally wholly pptd. if allowed to stand several days.

18752 pts. NH_4OH + Aq (4 % NH_4OH) dissolve an amt. of $Al_2O_6H_6$ corresponding to one pt. Al_2O_3; NH_4Cl prevents this solubility almost completely. (Hanamann, Pharm. Viertelj. **12.** 527.)

Conc. $(NH_4)_2CO_3$ + Aq does not dissolve $Al_2O_6H_6$, and not a trace is dissolved by boiling conc. NH_4Cl+Aq. (Weeren, Pogg. **92.** 97.)

With NH_4F+Aq, it forms a double salt, AlF_3, $3NH_4F$, which is sol. in H_2O, but not in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 127.)

Insol. in $(NH_4)_2S$+Aq. (Malaguti and Durocher, A. ch. (3) **17.** 421.) Fuchs found, on the contrary, that it is not wholly insol. in $(NH_4)_2S$+Aq. (Fresenius, Quant.)

Insol. in $FeCl_3$+Aq. (Béchamp.)

Sol. in $Ba(OH)_2$+Aq. (Rose.)

Sol. in boiling $Fe(NO_3)_3$, $Cr(NO_3)_3$, $Bi(NO_3)_3$, $Hg(NO_3)_2$, $HgNO_3$, $SnCl_2$, and $SbCl_3$+Aq. (Persoz.)

Insol. in HCN or cold KCN+Aq; but sl. sol. in hot KCN+Aq. (Rose.)

Insol. in $KC_2H_3O_2$+Aq. (Osann, 1821.)

When moist, sol. in H_2SO_3+Aq, from which it is repptd. on boiling. (Berthier, A. ch. (3) **7.** 76.)

Somewhat sol. in $NaC_2H_3O_2$+Aq. (Mercer.)

Not pptd. by NH_4OH+Aq in presence of Na citrate. (Spiller.)

Sol. in ethyl amine, amyl amine, sinkaline, ethyl picoline hydroxide, stibethylium hydroxide, triethyltoluenyl ammonium hydroxide +Aq. (Friedländer.)

Sol. to a considerable extent in $K_2C_4H_4O_6$+Aq.

Very sl. sol. in cane sugar+Aq. (Ramsey.)

Aluminum iodide, AlI_3.

Anhydrous. Fumes on air and deliquesces. Sol. in H_2O with evolution of much heat. Sol. in CS_2 and crystallises from the hot sat. solution on cooling. (Weber.) Sol. in alcohol (Weber); ether and tetra-chlormethane. (Gustavson.)

$+6H_2O$. Very sol. in H_2O.

Aluminum potassium iodide, AlI_3, KI.

Sol. in H_2O with evolution of much heat. (Weber, Pogg. **101.** 469.)

Aluminum iodide ammonia, AlI_3, $3NH_3$.

Decomp. by H_2O. (Weber, Pogg. **103.** 263.)

Aluminum nitride, Al_2N_2.

Slowly attacked by hot or cold H_2O. Decomp. by acids and aqueous solutions of the alkalies, especially when they are concentrated. (Mallet, A. **186.** 155.)

Aluminum oxide, Al_2O_3.

Crystalline. Min. *Corundum, sapphire, ruby, emery.* Insol. in acids.

Amorphous. Ignited Al_2O_3 is insol. in acids except that it dissolves slowly when heated with a mixture of 1 pt. H_2SO_4 and 1 pt. H_2O. (Berzelius.) Slowly sol. in boiling HCl+Aq. (Rose, Pogg. **52.** 595.)

Sol. in 22 pts. of a mixture of 8 pts. H_2SO_4 and 1 pt. H_2O. (Mitscherlich.) The lower the temperature at which Al_2O_3 has been heated, the more sol. is it in acids and alkalies.

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 1·35 g. Al_2O_3; 1 l. solution containing 296·5 g. sugar and 24·2 g. CaO dissolves 0·32 g. Al_2O_3; 1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·19 g. Al_2O_3. (Bodenbender, J. B. **1865.** 600.)

See also **Aluminum hydroxide.**

Aluminum oxybromide.

Basic aluminum bromides containing three equivalents or less of Al_2O_3 to one of $AlBr_3$ are sol. in H_2O. Those containing more than three equivalents are insol. (Ordway, Am. J. Sci. (2) **26.** 203.)

Aluminum oxychloride.

Sol. in dil. acids or alkalies. Decomp. by H_2O. (Hautefeuille and Perrey, C. R. **100.** 1220.)

Basic aluminum chlorides containing two equivalents or less of Al_2O_3 to one of $AlCl_3$ are sol. in H_2O. Those containing more than two equivalents are insol. (Ordway.)

Al_2O_3, $3AlCl_3+3H_2O$. (Tommasi, Bull. Soc. (2) **37.** 443.)

Al_2O_3, $8AlCl_3+3H_2O$. (Tommasi.)

$3Al_2O_3$, $AlCl_3+15H_2O$. (Tommasi.)

Aluminum phosphide.

Decomp. by H_2O. (Wöhler.)

Does not exist. (Erlenmeyer, B. **12.** 152.)

Aluminum selenide.

Decomp. by H_2O.

Aluminum silicide, Al_2Si_4.

More easily sol. in acids than Al. (Winkler, J. pr. **91.** 193.)

Aluminum sulphide, Al_2S_3.

Decomp. in moist air and by H_2O. (Wöhler.)

Aluminum potassium sulphide.

Violently decomposed by H_2O. (St. Claire Deville, J. pr. **71.** 293.)

Does not exist. (Gratama, R. t. c. **3.** 4.)

Aluminum telluride.

Decomp. by H_2O. (Wöhler, Pogg. **11.** 160.)

Aluminum titanide, Al_3Ti_2.

Slowly sol. in HCl+Aq. Violently oxidised by HNO_3+Aq.

*Di*amide, N_2H_4.

See **Hydrazine.**

Amidochromic acid.

Potassium amidochromate, $KCrO_3NH_2$.

Sol. only in H_2O. Sat. solution in H_2O contains 13 % of the salt. (Heintze, J. pr. (2) **4.** 214.)

Amidophosphoric acid, $HPO_3(NH_2) = PO(NH_2)(OH)_2$.

Sol. in H_2O, but decomp. on standing or by heat. (Stokes, Am. Ch. J. **15.** 198.)

Aluminum amidophosphate.

Ppt. Sol. in NH_4OH+Aq. (Stokes.)

Ammonium amidophosphate, $NH_4HPO_3(NH_2)$.

Very sol. in H_2O. (Stokes.)

Barium amidophosphate, $BaPO_3(NH_2)+H_2O$.

Very sl. sol. in H_2O. (Stokes.)

$BaH_2(PO_3NH_2)_2+2\frac{1}{4}H_2O$. Quite difficultly sol. in H_2O. (Stokes.)

Calcium amidophosphate, $CaPO_3(NH_2)$.

Much less sol. in H_2O than Ba salt. (Stokes.)

$CaH_2(PO_3NH_2)_2$. Much less sol. in H_2O than the Ba salt. (Stokes.)

Chromic amidophosphate.

Ppt. Sol. in warm NH_4OH+Aq. (Stokes.)

Cobalt amidophosphate.

Neutral. Ppt.

Acid. Sl. sol. in H_2O; sol. in NH_4OH+Aq.

Cupric amidophosphate.

Neutral. Sl. sol. in H_2O.

Acid. Nearly insol. in H_2O.

Ferrous amidophosphate.

Neutral. Sol. in much H_2O, and in $HC_2H_3O_2$, or NH_4OH+Aq.

Acid. Nearly insol. in H_2O or NH_4Cl+Aq. Sol. in NH_4OH+Aq.

Ferric amidophosphate.

Neutral. Ppt. Sol. in excess of alkali amidophosphate and in NH_4OH+Aq. Insol. in $HC_2H_3O_2$+Aq.

Acid. As the neutral salt.

Hydroxylamine amidophosphate, $(NH_3O)HPO_3(NH_2)$.

Sl. sol. in H_2O. (Stokes.)

Lithium amidophosphate, $LiHPO_3(NH_2)$.

Sl. sol. in H_2O. (Stokes.)

Magnesium amidophosphate, $MgPO_3(NH_2)+7H_2O$.

Very sl. sol. in H_2O; quite easily sol. in dil. NH_4Cl+Aq. Sol. in $HC_2H_3O_2$+Aq. (Stokes.)

$MgH_2(PO_3NH_2)_2+3\frac{1}{4}H_2O$. Insol. in NH_4Cl+Aq. (Stokes.)

Manganese amidophosphate.

Neutral. Ppt.

Acid. Sl. sol. in H_2O.

Nickel amidophosphate.

Neutral. Ppt. Sol. in $HC_2H_3O_2$ or NH_4OH+Aq.

Acid. Sl. sol. in H_2O.

Potassium amidophosphate, $K_2PO_3(NH_2)$.

Very sol. in H_2O and not decomp. by boiling. (Stokes.)

$KHPO_3(NH_2)$. Easily sol. in cold H_2O; insol. in alcohol. (Stokes.)

Silver amidophosphate, $Ag_2PO_3(NH_2)$.

Almost insol. in H_2O. Sol. in HNO_3 or NH_4OH+Aq.

$AgHPO_3(NH_2)$. Sl. sol. in H_2O; easily sol. in dil. HNO_3 or $HC_2H_3O_2$+Aq, also in NH_4OH+Aq.

Sodium amidophosphate, $Na_2PO_3(NH_2)$.

Not deliquescent; very sol. in H_2O; pptd. from aqueous solution by alcohol. (Stokes.)

$NaHPO_3(NH_2)+\frac{1}{4}(?)H_2O$. Nearly insol. in cold, and decomp. by hot H_2O. Insol. in alcohol.

Zinc amidophosphate.

Neutral. Perceptibly sol. in H_2O.

Acid. Sl. sol. in H_2O; sol. in NH_4OH or $HC_2H_3O_2$+Aq.

Amidosulphonic acid, $HOSO_2NH_2$.

Easily sol. in H_2O, less easily in alcohol. (Berglund, B. **9.** 252 and 1896.)

Very stable; less easily sol. in H_2O than its K salt. (Raschig, A. **241.** 177.)

Amidosulphonates.

Easily sol. in H_2O; sl. sol. in alcohol.

Aluminum amidosulphonate.

Very sol. in H_2O. (Berglund, Bull. Soc. (2) **29.** 422.)

Ammonium amidosulphonate, $(NH_4)NH_2SO_3$.

Deliquescent. Sol. in H_2O; insol. in alcohol.

Barium amidosulphonate, $Ba(NH_2SO_3)_2$.

Sol. in 3 pts. H_2O. (Berglund, *l.c.*)

Cadmium amidosulphonate, $Cd(NH_2SO_3)_2+5H_2O$.

Very sol. in H_2O. (B.)

Calcium amidosulphonate, $Ca(NH_2SO_3)_2+4H_2O$.

Very sol. in H_2O. (B.)

Cobalt amidosulphonate, $Co(NH_2SO_3)_2+3H_2O$.

Sol. in H_2O. (B.)

Copper amidosulphonate, $Cu(NH_2SO_3)_2+2H_2O$.

Sol. in H_2O. (B.)

Lead amidosulphonate, $Pb(NH_2SO_3)_2+H_2O$.

The most sol. of all amidosulphonates. (B.)

Lithium amidosulphonate. $LiNH_2SO_3$.

Deliquescent. (B.)

Magnesium amidosulphonate.

Very sol. in H_2O.

Manganese amidosulphonate, $Mn(NH_2SO_3)_2+3H_2O$.

Very sol. in H_2O. (B.)

Nickel amidosulphonate, $Ni(NH_2SO_3)_2+3H_2O$.

Sol. in H_2O. (B.)

Potassium amidosulphonate, KNH_2SO_3.

Sol. in H_2O. (Berglund.)

Silver amidosulphonate, $AgNH_2SO_3$.

Sol. in 15 pts. H_2O at 19°. (B.)

Sodium amidosulphonate, $NaNH_2SO_3$.
Sol. in H_2O.

Strontium amidosulphonate, $Sr(NH_2SO_3)_2 + 4H_2O$.
Sol. in H_2O.

Thallium amidosulphonate, $TlNH_2SO_3$.
Sol. in H_2O.

Uranyl amidosulphonate.
Sol. in H_2O.

Zinc amidosulphonate, $Zn(NH_2SO_3)_2 + 4H_2O$.
Sol. in H_2O.

Ammonia, NH_3.

Very sol. in H_2O, with evolution of much heat.

1 vol. H_2O absorbs 670 vols. (½ pt. by weight) NH_3 at +10° and 29·8 in. pressure; sp. gr. of solution = 0·875. (Davy.)

At low temperatures H_2O absorbs more than ½ its weight of NH_3, and sp. gr. of solution = 0·850. (Dalton.)

100 pts. H_2O absorb 8·41 pts. NH_3 at 24°; 5·96 pts. at 55°. (Osann.)

1 vol. H_2O absorbs 780 vols. NH_3, 6 vols. H_2O increasing to 10 vols. sat. $NH_4OH + Aq$; 1 vol. sat. $NH_4OH + Aq$ contains 468 vols. NH_3. (Thomson.)

1 vol. H_2O absorbs 450 vols. NH_3 at 15°. (Dumas.)

1 vol. H_2O absorbs 700 vols. NH_3 at ordinary temperature. (Otto.)

100 pts. H_2O absorb in NH_3 gas 47·7 pts. NH_3 by weight. (Berzelius.)

1 vol. H_2O absorbs 505 vols. NH_3 and vol. is increased to 1·5 vol., and sp. gr. becomes 0·900. (Ure.)

1 vol. H_2O at 0° and 760 mm. absorbs 1177·3 vols. NH_3. (Sims.)

1 vol. H_2O at 0° and 760 mm. absorbs 1146 vols. NH_3. (Roscoe and Dittmar.)

1 vol. H_2O at 0° and 760 mm. absorbs 1049·6 vols. NH_3. (Carius.)

1 vol. H_2O at 0° and 760 mm. absorbs 1270 vols. NH_3. (Berthelot.)

1 vol. H_2O at 0° and 760 mm. absorbs 1050 vols. NH_3. (Bunsen.)

100 ccm. H_2O absorb 64·50 g. NH_3. (Raoult.)

Solubility of NH_3 in H_2O at 760 mm. and t°: 1 g. H_2O absorbs g. NH_3, according to Roscoe and Dittmar (A. **112.** 347) (RD); and according to Sims (A. **118.** 345) (S).

t°	g. NH_3 RD	g. NH_3 S	t°	g. NH_3 RD	g. NH_3 S
0	0·875	0·899	36	0·343	0·363
2	0·833	0·853	38	0·324	0·350
4	0·792	0·809	40	0·307	0·338
6	0·751	0·765	42	0·290	0·326
8	0·713	0·724	44	0·275	0·315
10	0·679	0·684	46	0·259	0·304
12	0·645	0·646	48	0·244	0·294
14	0·612	0·611	50	0·229	0·284
16	0·582	0·578	52	0·214	0·274
18	0·554	0·546	54	0·200	0·265
20	0·526	0·518	56	0·186	0·256
22	0·499	0·490	58	...	0·247
24	0·474	0·467	60	...	0·238
26	0·449	0·446	70	...	0·194
28	0·426	0·426	80	...	0·154
30	0·403	0·408	90	...	0·114
32	0·382	0·393	98	...	0·082
34	0·362	0·378	100	...	0·074

Solubility of NH_3 by vol. in H_2O at 760 mm. and t°: 1 vol. H_2O at 760 mm. and t° dissolves V vols. NH_3 gas, vols. reduced to 0° and 760 mm.

t°	V	t°	V
0	1049·60	13	759·55
1	1020·78	14	743·11
2	993·26	15	727·22
3	966·98	16	711·82
4	941·88	17	696·85
5	917·90	18	682·26
6	894·99	19	667·99
7	873·09	20	653·99
8	852·14	21	640·19
9	831·98	22	626·54
10	812·76	23	612·98
11	794·32	24	599·46
12	776·60	25	585·94

(Carius, A. **99.** 144.)

Solubility of NH_3 in H_2O at P mm. pressure and 0°: 1 pt. H_2O absorbs pts. NH_3 at P mm. pressure and 0°.

P	Pts. NH_3	P	Pts. NH_3
10	0·044	900	0·968
20	0·084	950	1·101
30	0·120	1000	1·037
40	0·149	1050	1·075
50	0·175	1100	1·117
75	0·228	1150	1·161
100	0·275	1200	1·208
125	0·315	1250	1·258
150	0·351	1300	1·310
175	0·382	1350	1·361
200	0·411	1400	1·415
250	0·465	1450	1·469
300	0·515	1500	1·526
350	0·561	1550	1·584
400	0·607	1600	1·645
450	0·646	1650	1·707
500	0·690	1700	1·770
550	0·731	1750	1·835
600	0·768	1800	1·906
650	0·804	1850	1·976
700	0·840	1900	2·046
750	0·872	1950	2·120
800	0·906	2000	2·195
850	0·937	...	...

(Roscoe and Dittmar, A. **112.** 349.)

In proportion as the temperature is higher, so much the more nearly does the solubility of NH_3 in H_2O conform to the law of Henry and Dalton, but only obeys it completely when the temperature is 100°, as is seen in the following table.

Solubility of NH_3 in H_2O at various pressures and temperatures: P=partial pressure, *i.e.* total pressure minus the tension of aqueous vapour at the given temperature; G=grammes NH_3 dissolved in 1 g. H_2O at the given pressure; G at 760=number of grammes NH_3 that would be contained in 1 g. H_2O if the solubility was proportional to the pressure. (Sims, A. **118.** 346.)

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0·082	3·113	..	..	..	..	..	..
30	0·117	2·960	..	..	..	..	..	..
40	0·148	2·820	..	..	..	..	..	..
60	0·169	2·522	0·119	1·513	..	..	..	..
80	0·240	2·280	0·141	1·337	0·052	0·497	..	..
100	0·280	2·127	0·158	1·200	0·064	0·490	..	..
120	0·316	2·000	0·173	1·095	0·076	0·483	..	..
140	0·346	1·880	0·187	1·017	0·088	0·476	..	..
160	0·375	1·780	0·202	0·962	0·099	0·470	..	..
180	0·398	1·684	0·207	0·918	0·109	0·462	..	..
200	0·421	1·598	0·232	0·881	0·120	0·454	..	..
250	0·472	1·434	0·266	0·810	0·145	0·440		..
300	0·519	1·315	0·296	0·750	0·168	0·426	..	..
350	0·563	1·223	0·325	0·705	0·191	0·414	..	..
400	0·606	1·152	0·353	0·670	0·211	0·402	..	..
450	0·650	1·100	0·378	0·638	0·232	0·399	..	..
500	0·692	1·052	0·403	0·612	0·251	0·382	..	..
550	0·732	1·012	0·425	0·587	0·269	0·372	..	..
600	0·770	0·975	0·447	0·566	0·287	0·363	..	..
650	0·809	0·946	0·470	0·550	0·304	0·355	..	..
700	0·850	0·923	0·492	0·534	0·320	0·347	0·068	0·074
750	0·891	0·903	0·514	0·521	0·335	0·339	0·073	0·074
760	0·899	0·899	0·518	0·518	0·338	0·338	0·074	0·074
800	0·937	0·888	0·535	0·504	0·349	0·332	0·078	0·074
850	0·980	0·876	0·556	0·497	0·363	0·325	0·083	0·074
900	1·029	0·869	0·574	0·485	0·378	0·319	0·088	0·074
950	1·077	0·862	0·594	0·475	0·391	0·313	0·092	0·073
1000	1·126	0·855	0·613	0·466	0·404	0·307	0·096	0·073
1050	1·177	0·852	0·632	0·457	0·414	0·300	0·101	0·073
1100	1·230	0·850	0·651	0·450	0·425	0·294	0·106	0·073
1150	1·283	0·848	0·669	0·442	0·434	0·287	0·110	0·073
1200	1·336	0·846	0·685	0·433	0·445	0·282	0·115	0·073
1250	1·338	0·844	0·704	0·428	0·454	0·276	0·120	0·073
1300	1·442	0·843	0·722	0·422	0·463	0·271	0·125	0·073
1350	1·496	0·842	0·741	0·417	0·472	0·266	0·130	0·073
1400	1·549	0·841	0·761	0·413	0·479	0·260	0·135	0·073
1450	1·603	0·840	0·780	0·409	0·486	0·255	..	..
1500	1·656	0·839	0·801	0·406	0·493	0·250	..	..
1600	1·758	0·835	0·842	0·400	0·511	0·242	..	..
1700	1·861	0·832	0·881	0·394	0·530	0·237	..	..
1800	1·966	0·830	0·919	0·388	0·547	0·231	..	..
1900	2·070	0·828	0·955	0·382	0·565	0·226	..	..
2000	..	..	0·992	0·377	0·579	0·220	..	..
2100	..	..	..	..	0·594	0·215	..	..

Sp. gr. of NH_4OH+Aq.

% NH_3	Sp. gr.	% NH_3	Sp. gr.
32·3*	0·8750	14·53	0·9435
29·25	0·8857	13·46	0·9476
26	0·9000	12·40	0·9513
25·37*	0·9054	11·56	0·9545
22·07	0·9166	10·82	0·9573
19·54	0·9255	10·17	0·9597
17·52	0·9326	9·6	0·9616
15·88	0·9385	9·5*	0·9632

(H. Davy, Elements, 1. 241.)

* By direct experiment. The other numbers were obtained by calculation, making no allowance for compensation.

Sp. gr. of NH_4OH+Aq at 16°, according to Otto in his Lehrbuch.

% NH_3	Sp. gr.	% NH_3	Sp. gr.
12·000	0·9517	11·250	0·9545
11·875	0·9521	11·125	0·9550
11·750	0·9526	11·000	0·9555
11·625	0·9531	10·950	0·9556
11·500	0·9536	10·875	0·9559
11·375	0·9540	10·750	0·9564

Sp. gr. of NH_4OH+Aq at 16°, etc.—*Continued.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
10·625	0·9569	7·750	0·9678
10·500	0·9574	7·625	0·9683
10·375	0·9578	7·500	0·9688
10·250	0·9583	7·375	0·9692
10·125	0·9588	7·250	0·9697
10·000	0·9593	7·125	0·9702
9·875	0·9597	7·000	0·9707
9·750	0·9602	6·875	0·9711
9·625	0·9607	6·750	0·9716
9·500	0·9612	6·625	0·9721
9·375	0·9616	6·500	0·9726
9·250	0·9621	6·375	0·9730
9·125	0·9626	6·250	0·9735
9·000	0·9631	6·125	0·9740
8·875	0·9636	6·000	0·9745
8·750	0·9641	5·875	0·9749
8·625	0·9645	5·750	0·9754
8·500	0·9650	5·625	0·9759
8·375	0·9654	5·500	0·9764
8·250	0·9659	5·375	0·9768
8·125	0·9664	5·250	0·9773
8·000	0·9669	5·125	0·9778
7·875	0·9673	5·000	0·9783

Sp. gr. of NH_4OH+Aq, according to Ure in Dict. of Arts.

% NH_3	Sp. gr.	% NH_3	Sp. gr.
27·940	0·8914	15·900	0·9363
27·633	0·8937	14·575	0·9410
27·038	0·8967	13·250	0·9455
26·751	0·8983	11·925	0·9510
26·500	0·9000	10·600	0·9564
25·175	0·9045	9·275	0·9614
23·850	0·9090	7·950	0·9662
22·525	0·9133	6·625	0·9716
21·200	0·9177	5·300	0·9768
19·875	0·9227	3·975	0·9828
18·550	0·9275	2·650	0·9887
17·225	0·9320	1·325	0·9945

Sp. gr., b.-pt., and vols. gas in NH_4OH+Aq.

% NH_3	Sp. gr.	B.-pt.	Vols. gas in 1 vol. liquid
35·3	0·85	−3·3°	494
32·6	0·86	+3·3°	456
29·9	0·87	10°	419
27·3	0·88	16·6°	382
24·7	0·89	23·3°	346
22·2	0·90	30°	311
19·8	0·91	36·6°	277
17·4	0·92	43·3°	244
15·1	0·93	50°	211
12·8	0·94	56·6°	180
10·5	0·95	63·3°	147
8·3	0·96	70°	116
6·2	0·97	78·3°	87
4·1	0·98	86·1°	57
2·0	0·99	91·1°	28

(Dalton, in New System, **2.** 422.)

Sp. gr. of NH_4OH+Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	0·8535	9	0·8746	18	0·8903
1	0·8561	10	0·8766	19	0·8916
2	0·8587	11	0·8785	20	0·8928
3	0·8611	12	0·8804	21	0·8940
4	0·8635	13	0·8823	22	0·8952
5	0·8658	14	0·8841	23	0·8963
6	0·8681	15	0·8858	24	0·8974
7	0·8703	16	0·8874	25	0·8984
8	0·8725	17	0·8889	...	...

(Carius, A. **99.** 141.)

Sp. gr. of NH_4OH+Aq at 14°, according to Carius (A. **99.** 148).

% NH_3	Sp. gr.	% NH_3	Sp. gr.
36·0	0·8844	33·2	0·8903
35·8	0·8848	33·0	0·8907
35·6	0·8852	32·8	0·8911
35·4	0·8856	32·6	0·8916
35·2	0·8860	32·4	0·8920
35·0	0·8864	32·2	0·8925
34·8	0·8868	32·0	0·8929
34·6	0·8872	31·8	0·8934
34·4	0·8877	31·6	0·8938
34·2	0·8881	31·4	0·8944
34·0	0·8885	31·2	0·8948
33·8	0·8889	31·0	0·8953
33·6	0·8894	30·8	0·8957
33·4	0·8898	30·6	0·8962

Sp. gr. of NH_4OH+Aq at 14°, etc.—*Continued.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
30·4	0·8967	18·0	0·9314
30·2	0·8971	17·8	0·9321
30·0	0·8976	17·6	0·9327
29·8	0·8981	17·4	0·9333
29·6	0·8986	17·2	0·9340
29·4	0·8991	17·0	0·9347
29·2	0·8996	16·8	0·9353
29·0	0·9001	16·6	0·9360
28·8	0·9006	16·4	0·9366
28·6	0·9011	16·2	0·9373
28·4	0·9016	16·0	0·9380
28·2	0·9021	15·8	0·9386
28·0	0·9026	15·6	0·9393
27·8	0·9031	15·4	0·9400
27·6	0·9036	15·2	0·9407
27·4	0·9041	15·0	0·9414
27·2	0·9047	14·8	0·9420
27·0	0·9051	14·6	0·9427
26·8	0·9057	14·4	0·9434
26·6	0·9063	14·2	0·9441
26·4	0·9068	14·0	0·9449
26·2	0·9073	13·8	0·9456
26·0	0·9078	13·6	0·9463
25·8	0·9083	13·4	0·9470
25·6	0·9089	13·2	0·9477
25·4	0·9094	13·0	0·9484
25·2	0·9100	12·8	0·9491
25·0	0·9106	12·6	0·9498
24·8	0·9111	12·4	0·9505
24·6	0·9116	12·2	0·9512
24·4	0·9122	12·0	0·9520
24·2	0·9127	11·8	0·9527
24·0	0·9133	11·6	0·9534
23·8	0·9139	11·4	0·9542
23·6	0·9145	11·2	0·9549
23·4	0·9150	11·0	0·9556
23·2	0·9156	10·8	0·9563
23·0	0·9162	10·6	0·9571
22·8	0·9168	10·4	0·9578
22·6	0·9174	10·2	0·9586
22·4	0·9180	10·0	0·9593
22·2	0·9185	9·8	0·9601
22·0	0·9191	9·6	0·9608
21·8	0·9197	9·4	0·9616
21·6	0·9203	9·2	0·9623
21·4	0·9209	9·0	0·9631
21·2	0·9215	8·8	0·9639
21·0	0·9221	8·6	0·9647
20·8	0·9227	8·4	0·9654
20·6	0·9233	8·2	0·9662
20·4	0·9239	8·0	0·9670
20·2	0·9245	7·8	0·9677
20·0	0·9251	7·6	0·9685
19·8	0·9257	7·4	0·9693
19·6	0·9264	7·2	0·9701
19·4	0·9271	7·0	0·9709
19·2	0·9277	6·8	0·9717
19·0	0·9283	6·6	0·9725
18·8	0·9289	6·4	0·9733
18·6	0·9296	6·2	0·9741
18·4	0·9302	6·0	0·9749
18·2	0·9308	5·8	0·9757

gr. of $NH_4OH + Aq$ at 14°, etc.—*Continued.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
5·6	0·9765	2·8	0·9882
5·4	0·9773	2·6	0·9890
5·2	0·9781	2·4	0·9899
5·0	0·9790	2·2	0·9907
4·8	0·9799	2·0	0·9915
4·6	0·9807	1·8	0·9924
4·4	0·9815	1·6	0·9932
4·2	0·9823	1·4	0·9941
4·0	0·9831	1·2	0·9950
3·8	0·9839	1·0	0·9959
3·6	0·9847	0·8	0·9967
3·4	0·9855	0·6	0·9975
3·2	0·9863	0·4	0·9983
3·0	0·9873	0·2	0·9991

Hager also gives a table in his Commentar r Pharmacopoea, which is practically entical with those here given.

Strength of $NH_4OH + Aq$ of certain sp. gr. at 12°.

p. gr.	1 kg. solution contains g. NH_3	1 l. solution contains g. NH_3	1 litre consists of	
			H_2O in ccm.	liquid NH_3 in ccm.
0·870	384·4	334·5	535·5	464·5
0·880	347·2	305·5	574·5	425·5
0·890	311·6	277·3	612·7	387·3
0·900	277·3	249·5	650·5	349·5
0·910	244·9	222·8	687·2	312·8
0·920	213·4	196·3	723·7	276·3
0·930	182·9	170·1	759·9	240·1
0·940	152·9	143·7	796·3	203·7
0·950	124·2	118·0	832·0	168·0
0·960	97·0	93·1	866·9	133·1
0·970	70·2	68·0	902·0	98·0
0·980	45·3	44·3	935·7	64·3
0·990	21·0	20·7	969·3	30·7

(Wachsmuth, Arch. Pharm. (3) **8.** 510.)

Sp. gr. of $NH_4OH + Aq$ at 15°.
(Most careful experiments.)

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0·990	2·15	0·900	27·70
0·974	6·10	0·890	31·40
0·950	12·54	0·885	33·5
0·926	19·50	0·882	34·8
0·916	22·50	0·880	35·5
0·910	24·40	...	...

(Grüneberg, Chem. Ind. **12.** 97.)

The following table is calculated from the ove by interpolation :—

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0·995	1·05	0·975	5·75
0·990	2·15	0·970	7·05
0·985	3·30	0·965	8·40
0·980	4·50	0·960	9·80

(*Table continued.*)

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0·955	11·20	0·915	22·85
0·950	12·60	0·910	24·40
0·945	14·00	0·905	26·00
0·940	15·45	0·900	27·70
0·935	16·90	0·895	29·50
0·930	18·35	0·890	31·40
0·925	19·80	0·885	33·40
0·920	21·30	0·880	35·50

(Grüneberg.)

Sp. gr. of $NH_4OH + Aq$ at 14°.

% NH_3	Sp. gr.	% NH_3	Sp. gr.
31	0·8933	15·6	0·9400
23·8	0·9116	11·7	0·9536
20·4	0·9246	5·1	0·9780

(Lunge and Smith, B. **17.** 777.)

Sp. gr. of $NH_4OH + Aq$ at 15°, according to Lunge and Wiernik (Zeit. f. angew. Ch. **1889.** 183).
(Most carefully worked out and calculated.)

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
1·000	0·00	0·0	0·00018
0·998	0·45	4·5	0·00018
0·996	0·91	9·1	0·00019
0·994	1·37	13·6	0·00019
0·992	1·84	18·2	0·00020
0·990	2·31	22·9	0·00020
0·988	2·80	27·7	0·00021
0·986	3·30	32·5	0·00021
0·984	3·80	37·4	0·00022
0·982	4·30	42·2	0·00022
0·980	4·80	47·0	0·00023
0·978	5·30	51·8	0·00023
0·976	5·80	56·6	0·00024
0·974	6·30	61·4	0·00024
0·972	6·80	66·1	0·00025
0·970	7·31	70·9	0·00025
0·968	7·82	75·7	0·00026
0·966	8·33	80·5	0·00026
0·964	8·84	85·2	0·00027
0·962	9·35	89·9	0·00028
0·960	9·91	95·1	0·00029
0·958	10·47	100·3	0·00030
0·956	11·03	105·4	0·00031
0·954	11·60	110·7	0·00032
0·952	12·17	115·9	0·00033
0·950	12·74	121·0	0·00034
0·948	13·31	126·2	0·00035
0·946	13·88	131·3	0·00036
0·944	14·46	136·5	0·00037
0·942	15·04	141·7	0·00038
0·940	15·63	146·9	0·00039
0·938	16·22	152·1	0·00040
0·936	16·82	157·4	0·00041
0·934	17·42	162·7	0·00041
0·932	18·03	168·1	0·00042
0·930	18·64	173·4	0·00042

Sp. gr. of $NH_4OH + Aq$ at 15°, etc.—*Continued.*

(Most carefully worked out and calculated.)

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
0·928	19·25	178·6	0·00043
0·926	19·87	184·2	0·00044
0·924	20·49	189·3	0·00045
0·922	21·12	194·7	0·00046
0·920	21·75	200·1	0·00047
0·918	22·39	205·6	0·00048
0·916	23·03	210·9	0·00049
0·914	23·68	216·3	0·00050
0·912	24·33	221·9	0·00051
0·910	24·99	227·4	0·00052
0·908	25·65	232·9	0·00053
0·906	26·31	238·3	0·00054
0·904	26·98	243·9	0·00055
0·902	27·65	249·4	0·00056
0·900	28·33	255·0	0·00057
0·898	29·01	260·5	0·00058
0·896	29·69	266·0	0·00059
0·894	30·37	271·5	0·00060
0·892	31·05	277·0	0·00060
0·890	31·75	282·6	0·00061
0·888	32·50	288·6	0·00062
0·886	33·25	294·6	0·00063
0·884	34·10	301·4	0·00064
0·882	34·95	308·3	0·00065

NH_3 is much less sol. in KOH, or $NaOH + Aq$ than in H_2O.

Solubility of NH_3 in H_2O, and $KOH + Aq$ of various strengths: 100 pts. solvent absorb g. NH_3 at t°.

t°	H_2O	$KOH + Aq$ 11·25% K_2O	$KOH + Aq$ 25·25% K_2O
0	90·00	72·00	49·50
8	72·75	57·00	37·50
16	59·75	46·00	28·50
24	49·50	37·25	21·75

(Raoult, A. ch. (5) **1.** 262.)

100 pts. sat. $KOH + Aq$ dissolve only 1 pt. NH_3.

Solubility in $NaOH + Aq$ is the same as in $KOH + Aq$ of the same strength.

$NH_4Cl + Aq$ absorbs slightly less NH_3 than the same vol. H_2O. $NaNO_3$, and $NH_4NO_3 + Aq$ absorb almost the same amount NH_3 as the same vol. H_2O. (Raoult, *l.c.*)

Solubility of NH_3 in 100 pts. $Ca(NO_3)_2 + Aq$.

t°	H_2O	$Ca(NO_3)_2 + Aq$ 28·38% $Ca(NO_3)_2$	$Ca(NO_3)_2 + Aq$ 59·03% $Ca(NO_3)_2$
0	90·00	96·25	104·50
8	72·75	78·50	84·75
16	59·75	65·00	70·50

(Raoult, *l.c.*)

Sol. in alcohol and ether.

Much less sol. in ethyl, propyl, or amyl alcohol than in H_2O. (Pagliano and Emo, Gazz. ch. it. **13.** 278.)

Sol. in 3 pts. alcohol of 38° (Boullay.)

1 vol. alcohol of 0·829 sp. gr. absorbs about 50 vols. NH_3. (Davy.)

Solubility of NH_3 in alcohol at t°: weight NH_3 = weight NH_3 contained in a litre of solution sat. at 760 mm. and t°; sp. gr. = sp. gr. of solution; C = coefficient of solubility.

Temp.	Degree of Alcohol	100°	90°	80°	70°	60°	50°
0°	Weight NH_3	130·5	146·0	206·5	...	246·0	304·5
	Sp. gr.	0·782	0·783	0·808	...	0·830	0·835
	C	209·5	245·0	390·0	...	504·5	697·7
10°	Weight NH_3	108·5	120·0	167·0	...	198·25	227·0
	Sp. gr.	0·787	0·803	0·800	...	0·831	0·850
	C	164·3	186·0	288·0	...	373·0	438·6
20°	Weight NH_3	75·0	97·5	119·75	137·5	152·5	182·7
	Sp. gr.	0·791	0·788	0·821	0·829	0·842	0·869
	C	106·6	147·8	190·5	223·0	260·8	338·2
30°	Weight NH_3	51·5	74·0	81·75	100·3	129·5	152·0
	Sp. gr.	0·798	0·791	0·826	...	0·846	0·883
	C	97·0	186·7	121·6	...	211·6	252·0

(Delépine, J. Pharm. (5) **25.** 496.)

1 l. methyl alcohol sat. with NH_3 contains 218 g. NH_3 at 0°; sp. gr. of solution = 0·770; coefficient of solubility = 425·0. (Delépine.)

Solubility of NH_3 in ethyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	19·7	24·5
6	17·1	20·6
11·7	14·1	16·4
14·7	13·2	15·2
17	12·6	14·7
22	10·9	12·2
28·4	9·2	10·1

(de Bruyn, R. t. c. **11.** 112.)

Solubility of NH_3 in methyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	29·3	41·5
6	26·0	35·2
11·7	23·5	30·7
14·7	21·8	27·9
17	20·8	26·3
22	18·3	22·4
28·4	14·8	17·4

(de Bruyn, *l.c.*)

Readily sol. in ether.

Sol. in 0·4 vol. petroleum from Amiano. (Saussure.)

1 vol. oil of turpentine absorbs 7·5 vols. NH_3 at 16°.

1 vol. oil of lemon absorbs 8·5 vols. NH_3 at 16°.

1 vol. oil of rosemary absorbs 9·75 vols. NH_3 at 29°.

1 vol. oil of lavender absorbs 47 vols. NH_3 at 20°. (Saussure.)

1 vol. caoutchine absorbs 3 vols. NH_3. (Himly.)

Valerol absorbs much NH_3. (Gerhardt, A. ch. (3) **7.** 278.)

Ammonia, with metal salts.

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg, and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc. compounds, for further reference.

Ammonium amalgam, NH_4, xHg.

Decomp. by H_2O, but more easily in presence of naphtha, alcohol, or ether.

Ammonium azoimide, $N_4H_4=NH_4N_3$.

Easily sol. in H_2O; sl. sol. in absolute alcohol, easily in 80% alcohol. Insol. in ether or benzene. (Curtius, B. **24.** 3344.)

Ammonium bromide, NH_4Br.

Easily sol. in H_2O with absorption of much heat.

1 pt. NH_4Br dissolves in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
10	1·51	30	1·23	100	0·78
16	1·39	50	1·06	...	...

(Eder, W. A. B. **82.** (2) 1284.)

Sp. gr. of NH_4Br+Aq at 15°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
5	1·0326	20	1·1285
10	1·0652	30	1·1921
15	1·0960	41·09	1·2920

(Eder.)

Sp. gr. of NH_4Br+Aq at 16°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
2	1·0119	22	1·1375
3	1·0181	23	1·1440
4	1·0242	24	1·1506
5	1·0303	25	1·1573
6	1·0364	26	1·1642
7	1·0425	27	1·1713
8	1·0486	28	1·1787
9	1·0547	29	1·1862
10	1·0609	30	1·1938
11	1·0672	31	1·2018
12	1·0735	32	1·2098
13	1·0798	33	1·2180
14	1·0862	34	1·2260
15	1·0926	35	1·2342
16	1·0988	36	1·2425
17	1·1051	37	1·2509
18	1·1115	38	1·2594
19	1·1181	39	1·2679
20	1·1246	40	1·2765
21	1·1310	41	1·2850

(Hager, Comm. **1883.**)

NH_4Br+Aq containing 41·09 % NH_4Br is sat. at 15°. (Gerlach.)

25 g. NH_4Br + 50 g. H_2O lower the temp. from 15·1° to −1·1°. (Rüdorff.)

Sl. sol. in alcohol.

1 pt. NH_4Br dissolves in 32·3 pts. alcohol (0·806 sp. gr.) at 15°; 9·5 pts. at 78°. (Eder, *l.c.*)

Sol. in 809 pts. ether (0·729 sp. gr.). (Eder, *l.c.*)

100 pts. absolute methyl alcohol dissolve 12·5 pts. at 19°; 100 pts. absolute ethyl alcohol dissolve 3·22 pts. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Ammonium *tri*bromide, NH_4Br_3.

Gives off Br in air. Sol. in H_2O. (Roozeboom, B. **14.** 2398.)

Ammonium bismuth bromide, $NH_4Br, BiBr_3+H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in alcohol. (Nicklès, C. R. **51.** 1097.)

Ammonium cadmium bromide, $NH_4Br, CdBr_2+\frac{1}{2}H_2O$.

Sol. in 0·73 pt. H_2O, 5·3 pts. abs. alcohol, 280 pts. ether (sp. gr. 0·729), and 24 pts. alcohol ether (1 : 1). (Eder, Dingl. **221**. 89.)

$4NH_4Br, CdBr_2$. Sol. in 0·96 pt. H_2O, from which it is pptd. by alcohol or ether. (Eder.)

Ammonium chloromolybdenum bromide, $2NH_4Br, Cl_4Mo_3Br_2$.

Decomp. by pure H_2O. Can be crystallised from HBr+Aq. Apparently sol. without decomp. in alcohol. (Blomstrand.)

Ammonium cupric bromide, $2NH_4Br, CuBr_2+2H_2O$.

Very sol. in H_2O. (de Koninck, B. **21**. 777 R.)

Ammonium ferric bromide (?).

Sol. in H_2O. (Löwig.)

Ammonium lead bromide, $12NH_4Br, 7PbBr_2+7H_2O$.

Decomp. on air, or with cold H_2O. (André, C. R. **96**. 1502.)

$6NH_4Br, PbBr_2+H_2O$. Decomp. by cold H_2O. (A.)

$7NH_4Br, PbBr_2+1\frac{1}{2}H_2O$. Stable on air; decomp. by cold H_2O. (A.)

None of the above compounds exist. (Wells, Sill. Am. J. **146**. 25.)

$2NH_4Br, PbBr_2+H_2O$. (Wells.)

$NH_4Br, 3PbBr_2$. (Wells.)

Ammonium magnesium bromide, $NH_4Br, MgBr_2+6H_2O$.

Deliquescent. Sol. in H_2O. (Lerch, J. pr. (2) **28**. 338.)

Ammonium mercury bromide (?).

Sol. in NH_4Br+Aq. (Löwig.)

Ammonium molybdenum bromide chloride.

See **Ammonium chloromolybdenum bromide.**

Ammonium selenium bromide.

See **Bromoselenate, ammonium.**

Ammonium thallic bromide, $NH_4Br, TlBr_3+2H_2O$.

Sol. in H_2O. (Willm.)

$+4H_2O$. Efflorescent. Sol. in H_2O. (Nicklès.)

$+5H_2O$. Sol. in H_2O. (Nicklès.)

Ammonium stannous bromide (ammonium bromostannite), $NH_4Br, SnBr_2+H_2O$.

Sol. in H_2O. (Benas, C. C. **1884**. 958.)

$2NH_4Br, SnBr_2$. Sol. in H_2O. (Raymann and Preis, A. **223**. 323.)

$+H_2O$. Sol. in H_2O. (Benas, *l.c.*)

$+2H_2O$. (Richardson, Am. Ch. J. **14**. 96.)

$NH_4Br, 2SnBr_2$ (?). (Benas.)

Ammonium stannic bromide, $2NH_4Br, SnBr_4$.

See **Bromostannate, ammonium.**

Ammonium uranyl bromide, $2NH_4Br, UO_2Br_2+2H_2O$.

Very deliquescent, and sol. in H_2O. (Sendtner.)

Ammonium zinc bromide, $2NH_4Br, ZnBr_2$.

Deliquescent, and sol. in H_2O. (Bödeker, J. B. **1860**. 17.)

$+H_2O$. Very deliquescent, and sol. in H_2O. (André, A. ch. (6) **3**. 104.)

Ammonium bromide arsenic ***tri*****oxide.**

See **Arsenite bromide, ammonium.**

Ammonium chloride, NH_4Cl.

(*Sal-ammoniac*). Not deliquescent. Sol. in H_2O with reduction of temp.

Sol. in 2·24 pts. H_2O. (Wenzel.)

NH_4Cl+Aq sat. at 10° has sp. gr. = 1·072. (T.)

Sol. in 2·72 pts. cold, and 1 pt. boiling H_2O. (M. R., and P.)

Sol. in 3 pts. H_2O at 18·75°. (Abl.)

Sol. in 6 pts. cold, and 1 pt. boiling H_2O. (Fourcroy.)

100 pts. H_2O at 18·75° dissolve 36·75 pts. NH_4Cl.

NH_4Cl+Aq sat. at its b.-pt. (114·2°) contains 88·9 pts. NH_4Cl in 100 pts. of the solution. (Berzelius.)

100 pts. H_2O at 15° dissolve 33-36 pts.; and at 100°, 100 pts. NH_4Cl. (Ure's Dict.)

NH_4Cl+Aq sat. at 15° has sp. gr. = 1·075209, and contains at least 31·88 pts. NH_4Cl dissolved in every 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41**. 478.)

NH_4Cl+Aq sat. at 10° contains 23·8% NH_4Cl. (Eller.)

NH_4Cl+Aq sat. in the cold contains 14·3% NH_4Cl. (Fourcroy.)

Sol. in 1 pt. H_2O at 113·5°, b.-pt. of sat. solution. (Griffiths.)

Sol. in 2·7 pts. H_2O at 18·75°, forming a liquid of 1·08 sp. gr. (Karsten, 1840.)

Sol. in 2·727 pts. H_2O at 10°. (Gren's Handbuch.)

100 pts. H_2O at 718 mm. pressure and t° dissolve pts. NH_4Cl.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	28·40	30	41·72	60	55·04	90	68·36
10	32·84	40	46·16	70	59·48	100	72·80
20	37·28	50	50·60	80	63·92	110	77·24

(Alluard, C.R. **59**. 500.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29·7	30	41·4	60	55·2	90	71·3
1	30·0	31	41·8	61	55·7	91	71·9
2	30·3	32	42·2	62	56·2	92	72·5
3	30·6	33	42·7	63	56·7	93	73·1
4	31·0	34	43·1	64	57·2	94	73·7
5	31·4	35	43·6	65	57·7	95	74·3
6	31·8	36	44·0	66	58·2	96	74·9
7	32·2	37	44·4	67	58·7	97	75·5
8	32·6	38	44·9	68	59·2	98	76·1
9	33·0	39	45·3	69	59·7	99	76·7
10	33·3	40	45·8	70	60·2	100	77·3
11	33·7	41	46·2	71	60·7	101	78·0
12	34·1	42	46·7	72	61·2	102	78·6
13	34·5	43	47·1	73	61·7	103	79·2
14	34·8	44	47·6	74	62·3	104	79·9
15	35·2	45	48·0	75	62·8	105	80·5
16	35·6	46	48·5	76	63·4	106	81·2
17	36·0	47	49·0	77	63·9	107	81·8
18	36·4	48	49·5	78	64·5	108	82·5
19	36·8	49	49·9	79	65·1	109	83·1
20	37·2	50	50·4	80	65·6	110	83·8
21	37·6	51	50·9	81	66·2	111	84·4
22	38·0	52	51·3	82	66·7	112	85·1
23	38·4	53	51·8	83	67·3	113	85·7
24	38·8	54	52·3	84	67·8	114	86·4
25	39·3	55	52·8	85	68·4	115	87·1
26	39·7	56	53·2	86	69·0	115·65	87·3
27	40·1	57	53·7	87	69·6	...	...
28	40·5	58	54·2	88	70·2	...	...
29	40·9	59	54·7	89	70·7	...	...

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864**. 57.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29·7	10·8	33·9	64·9	57·9
6·2	32·2	31·6	42·2	90·6	67·2

(Lindström, Pogg. **136**. 315.)

NH_4Cl+Aq sat. at 13-16° contains 26·16 % NH_4Cl. (v. Hauer, J. pr. **103**. 114.)

Sol. in 2·72 pts. H_2O at 19°. (Schiff, A. **109**. 326.)

Sol. in 2·803 pts. H_2O at 15°. (Gerlach.)

Spec. gravity of NH_4Cl+Aq. G=according to Gerlach at 15° (Z. anal. **8**. 281); S=according to Schiff at 19° (A. **110**. 74).

% NH_4Cl	Sp. gr.		% NH_4Cl	Sp. gr.	
	G	S		G	S
1	1·00316	1·0029	17	1·05086	1·0495
2	1·00632	1·0058	18	1·05367	1·0523
3	1·00948	1·0087	19	1·05648	1·0551
4	1·01264	1·0116	20	1·05929	1·0579
5	1·01580	1·0145	21	1·06204	1·0606
6	1·01880	1·0174	22	1·06479	1·0633
7	1·02180	1·0203	23	1·06754	1·0660
8	1·02481	1·0233	24	1·07029	1·0687
9	1·02781	1·0263	25	1·07304	1·0714
10	1·03081	1·0293	26	1·07375	1·0741
11	1·03370	1·0322	26·297	1·07658	...
12	1·03658	1·0351	27	...	1·0768
13	1·03947	1·0380	28	...	1·0794
14	1·04325	1·0409	29	...	1·0820
15	1·04524	1·0438	30	...	1·0846
16	1·04805	1·0467	...	...	...

For older determinations, see Storer's Dict.

Sp. gr. of NH_4Cl+Aq at 18°.

% NH_4Cl	Sp. gr	% NH_4Cl	Sp. gr.
5	1·0142	20	1·0571
10	1·0289	25	1·0710
15	1·0430	...	...

(Kohlrausch, W. Ann. **1879**. 1.)

B.-pt. of NH_4Cl+Aq, containing pts. NH_4Cl to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26**. 439); L=according to Legrand (A. ch. (2) **59**. 436).

B.-pt.	G	L	B.-pt.	G	L
101°	6·5	7·8	109°	50·6	53·5
102	12·8	13·9	110	56·2	59·9
103	19·0	19·7	111	61·9	66·4
104	24·7	25·2	112	67·8	73·3
105	29·7	30·5	113	74·2	80·5
106	34·6	35·7	114	81·3	88·1
107	39·6	41·3	114·2	...	88·9
108	45·0	47·3	114·8	87·1	...

Sat. NH_4Cl+Aq boils at 115·8° at 718 mm. pressure. (Alluard, C. R. **59**. 500.)

NH_4Cl+Aq containing 74·2 pts. NH_4Cl to 100 pts. H_2O forms a crust at 113°; highest temperature observed, 114·8°. (Gerlach, Z. anal. **26**. 426.)

NH_4Cl+Aq containing 10 % NH_4Cl boils at 101·7°; 20 % NH_4Cl, at 104·4°. (Gerlach.)

NH_4Cl+Aq containing 10·6 % NH_4Cl gives off NH_3 at 37°. (Leeds, Am. J. Sci. (3) **7**. 197.)

When NH_4Cl+Aq is boiled, or even evap. on water bath, a little NH_3 is expelled. (Fresenius.)

30 pts. NH_4Cl mixed with 100 pts. H_2O lower the temp. from 13·3° to −5·1°, that is 18·4°. (Rüdorff, B. **2**. 68.)

Freezing-point of sat. solution is −15·4°, the same temp. which is caused by mixing 25 pts. NH_4Cl with 100 pts. snow. (Rüdorff, Pogg. **122**. 337.)

Conc. HCl+Aq precipitates part of NH_4Cl from sat. NH_4Cl+Aq. (Vogel, J. pr. **2**. 199.)

Solubility of NH_4Cl in HCl+Aq at 0°. NH_4Cl =mols. NH_4Cl (in milligrammes) dissolved in 10 ccm. of the liquid; HCl=mols. HCl (in milligrammes) dissolved in 10 ccm. of the liquid.

NH_4Cl	HCl	Sum of mols.	Sp. gr.
46·125	0·0	46·125	1·076
43·6	2·9	46·5	1·0695
41·0	5·5	46·5	1·0705
39·15	7·85	47·0	1·0715
36·45	10·85	47·30	1·073
27·37	21·4	48·77	1·078
10·875	53·0	63·875	1·106
8·8	61·0	69·8	1·114

(Engel, Bull. Soc. (2) **45**. 655.)

100 pts. H_2O dissolve 33·8 pts. NH_4Cl+11·6 pts. $BaCl_2$ at 20°. (Rüdorff, Pogg. **148**. 467.)

100 pts. H_2O dissolve 29·1 pts. NH_4Cl+173·8 pts. NH_4NO_3 at 19·5°. (Rüdorff, B. **6**. 482.)

$NH_4Cl+Ba(NO_3)_2$. 100 pts. H_2O dissolve at 18·5°—

	1	2	3	4	5
NH_4Cl	36·7	38·6	38·06	39·18	...
$Ba(NO_3)_2$	...	8·6	16·73	17·02	8·9

2, sat. $Ba(NO_3)_2$+Aq treated with NH_4Cl; 3, sat. NH_4Cl+Aq treated with $Ba(NO_3)_2$; 4, simultaneous treatment of both salts with H_2O. (Karsten.)

$NH_4Cl+KNO_3$. 100 pts. H_2O dissolve at 18·5°—

	1	2	3	4	5	6
KNO_3	29·9	30·56	37·68	38·62	...	34·2
NH_4Cl	...	44·33	37·98	39·84	36·7	38·8
		74·89	75·66	78·46		73·0

1 and 5, according to Mulder; 2, sat. KNO_3 + Aq treated with NH_4Cl; 3, sat. NH_4Cl + Aq treated with KNO_3; 4, simultaneous treatment of NH_4Cl and KNO_3 (Karsten); 6, by warming solution with excess of both salts, and cooling to 14·8°. The amount of excess of one or the other salt has no influence. (Rüdorff.)

Slowly sol. in sat. $NaNO_3$ + Aq, at first to a clear solution, but afterwards NaCl separates out. (Karsten.)

NH_4Cl + KCl. 100 pts. H_2O dissolve—

	(Rüdorff) 15°	(Karsten) 18·75°		
KCl . . .	16·97	34·4	16·27	...
NH_4Cl . .	28·90	...	29·83	37·02

	(Rüdorff) 22°	(Mulder) At b.-pt.		
KCl . . .	19·1	58·5	21·9	...
NH_4Cl . .	30·4	...	67·7	87·3

100 pts. sat. solution of NH_4Cl + KCl contain 30·61 pts. of the two salts at 13-16°. (v. Hauer, J. pr. **103**. 114.)

NH_4Cl + NaCl. 100 pts. H_2O dissolve—

	(Mulder) 10-20°	10°	10°	(v. Hauer) 13-16°
NH_4Cl .	...	19·50	33·3	18·8-20·3
NaCl .	35·8	30·00	...	24·6-26·1
		49·50		43·4-46·4

	(Karsten) 18·75°		(Rüdorff) 18·7°	(Mulder) At b.-pt.		
NH_4Cl	22·06	37·02	22·9	87·3	78·5	...
NaCl .	26·38	...	23·9	...	22·3	40·4
	48·44		46·8		100·8	

Sp. gr. of sat. solution of NH_4Cl + NaCl is 1·179. (Karsten.)

100 pts. H_2O dissolve 26·8 pts. NH_4Cl + 46·5 pts. $(NH_4)_2SO_4$ at 21·5°. (Rüdorff, B. **6**. 484.)

Sol. in sat. $CuSO_4$ + Aq, at first to a clear solution, but a double sulphate of NH_4 and Cu soon separates. (Karsten.)

Slowly and difficultly sol. in sat. $MgSO_4$ + Aq with subsequent separation of double sulphate. (Karsten.)

NH_4Cl + K_2SO_4. 100 pts. H_2O dissolve, at 18·75°—

		a	*b*	*c*	
K_2SO_4 .	10·8	11·1	13·26	13·28	...
NH_4Cl .	...	38·2	37·94	37·92	36·7
		49·3	51·20	51·20	

In (*a*) NH_4Cl was added to sat. K_2SO_4 + Aq.

In (*b*) K_2SO_4 was added to sat. NH_4Cl + Aq.

In (*c*) NH_4Cl and K_2SO_4 were treated together with H_2O. (Karsten.)

100 pts. H_2O at 14° dissolve 14·1 pts. K_2SO_4 + 36·8 pts. NH_4Cl = 50·9 pts. K_2SO_4 + NH_4Cl, under all conditions. (Rüdorff, Pogg. **148**. 565.)

100 pts. H_2O at b.-pt. dissolve—

K_2SO_4 . .	26·75	33·3- 33·9	...
NH_4Cl . .	...	90·4-111·8	87·3
		123·7-145·7	

(Mulder.)

NH_4Cl + Na_2SO_4.

100 pts. H_2O dissolve 28·9 pts. NH_4Cl + 24·7 pts. Na_2SO_4, if NH_4Cl + Aq sat. at 10° is sat. with Na_2SO_4 at 11°.

100 pts. H_2O dissolve 31·8 pts. NH_4Cl + 9·0 pts. Na_2SO_4, if Na_2SO_4 + Aq sat. at 10° is sat. with NH_4Cl at 11°. (Mulder, J. B. **1866**. 68.)

Sol. in sat. Na_2SO_4 + Aq. (Karsten.)

Sol. in sat. $ZnSO_4$ + Aq. (Karsten.)

Solubility in NH_4OH + Aq. NH_4Cl = mols. NH_4Cl (in mgs.) in 10 ccm. solution; NH_3 = mols. NH_3 (in mgs.) in 10 ccm. solution.

NH_4Cl	NH_3	Sp. gr.
46·125	0	1·076
45·8	5·37	1·067
45·5	12·025	1·054
45·125	23·4	1·044
44·5	38·0	1·031
44·0	47	1·025
43·625	54·5	1·017
43·125	80·0	0·993
44·0	90·0	0·992
44·375	95·5	0·983
49·75	130	0·953
60·0	169·75	0·931

(Engel, Bull. Soc. (3) **6**. 17.)

Very sl. sol. in absolute alcohol.

100 pts. alcohol of 0·939 sp. gr. dissolve—

at	4°	8°	27°	38°	56°
	11·2	12·6	19·4	23·6	30·1 pts. NH_4Cl.

(Gerardin, A. ch. (4) **5**. 129.)

14 pts. boiling highest rectified spirit dissolve 1 pt. NH_4Cl. (Wenzel.)

100 pts. alcohol of—

0·900 sp. gr. dissolve 6·5 pts. NH_4Cl.
0·872 " " " 4·75 " "
0·834 " " " 1·5 " "

(Kirwan.)

Though somewhat sol. in pure absolute alcohol, NH_4Cl is absolutely insol. in alcohol in presence of methyl amine chlorides. (Winkles, A. **93**. 324.)

100 pts. absolute methyl alcohol dissolve 3·35 pts. at 19°.

100 pts. absolute ethyl alcohol dissolve 0·62 pt. at 19°. (de Bruyn, Z. phys. Ch. **10**. 783.)

Insol. in ether and CS_2. (Fordos and Gélis, A. ch. (3) **32**. 393.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. anal. appl. Ch. **6.** 184.)

Ammonium antimonous chloride, NH_4Cl, $SbCl_3$.

Deliquescent. (Dehérain, C. R. **52.** 734.)

$2NH_4Cl$, $SbCl_3+2H_2O$. Permanent in dry air; decomp. by much H_2O. (Poggiale.)

$3NH_4Cl$, $SbCl_3+3H_2O$. As above.

Ammonium antimonic chloride, $3NH_4Cl, SbCl_5$.

Decomp. by H_2O. (Dehérain, C. R. **52.** 734.)

$4NH_4Cl$, $SbCl_5$. Decomp. by H_2O. (D.)

Ammonium arsenyl chloride, $2NH_4Cl$, $AsOCl+\frac{1}{2}H_2O$.

(Wallace, Phil. Mag. (4) **16.** 358.)

Ammonium bismuth chloride, NH_4Cl, $2BiCl_3$.

Deliquescent. (Dehérain, C. R. **54.** 724.)

$2NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe, Pogg. **64.** 237.)

$+2\frac{1}{2}H_2O$. (Rammelsberg.)

$3NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe.)

$5NH_4Cl$, $2BiCl_3$. (Rammelsberg.)

Ammonium bismuth potassium chloride, $2NH_4Cl$, $BiCl_3$, KCl.

(Dehérain, C. R. **54.** 724.)

Ammonium cadmium chloride, $2NH_4Cl$, $2CdCl_2+H_2O$.

Sl. sol. in H_2O, alcohol, and wood spirit. (v. Hauer, W. A. B. **13.** 449.)

$4NH_4Cl$, $CdCl_2$. Sol. in H_2O. (v. Hauer.)

Ammonium chloromolybdenum chloride, $2NH_4Cl$, $Cl_4Mo_3Cl_2+2H_2O$.

Decomp. by pure H_2O; can be crystallised from $HCl+Aq$. (Blomstrand.)

Ammonium chromium chloride, $2NH_4Cl$, $CrCl_3+H_2O$.

Sol. in H_2O with decomp. (Neumann, A. **244.** 229.)

Ammonium cobaltous chloride, NH_4Cl, $CoCl_2+6H_2O$.

Deliquescent in moist air. Very easily sol. in H_2O. (Hautz, A. **66.** 284.)

Ammonium cobaltous chloride ammonia, NH_4Cl, $CoCl_2$, NH_3.

(F. Rose.)

Ammonium cuprous chloride, $4NH_4Cl, 3Cu_2Cl_2$.

Decomp. by H_2O, not by alcohol. (Ritthausen, J. pr. **59.** 369.)

Ammonium cupric chloride, NH_4Cl, $CuCl_2+2H_2O$.

Sol. in 2 pts. H_2O. (Hautz, A. **66.** 280.)

$2NH_4Cl$, $CuCl_2+2H_2O$. Easily sol. in H_2O, also in alcohol, even when absolute. (Cap and Henry, J. pr. **13.** 184.)

Ammonium cupric chloride ammonia, $2NH_4Cl$, $CuCl_2$, $2NH_3$.

Decomp. by H_2O, less easily by alcohol. Decomp. by acids. (Ritthausen.)

Ammonium indium chloride, $2NH_4Cl$, $InCl_3+H_2O$.

Easily sol. in H_2O. (Meyer.)

Ammonium iodine chloride, NH_4Cl, ICl_3.

More sol. in H_2O than KCl, ICl_3. (Filhol, J. Pharm. **25.** 441; Berz. J. B. **20.** (2) 110.)

Ammonium iridium chloride.

See **Chloriridate, ammonium.**

Ammonium ferrous chloride, NH_4Cl, $FeCl_2$.

Easily sol. in H_2O; insol. in alcohol. (Winkler.)

Ammonium ferric chloride, $2NH_4Cl$, $FeCl_3+H_2O$.

Deliquescent. Sol. in H_2O without decomp. (Fritzsche); sol. in 3 pts. H_2O at 18·75°. (Abl.)

Ammonium ferric potassium chloride, NH_4Cl, $FeCl_3$, $KCl+1\frac{1}{2}H_2O$.

Min. *Kremersite.* Deliquescent.

Ammonium lead chloride, NH_4Cl, $2PbCl_2+3H_2O$.

Sol. in H_2O without decomp. (?). (André, C. R. **96.** 1502.)

$6NH_4Cl$, $PbCl_2+H_2O$.
$9NH_4Cl$, $PbCl_2+1\frac{1}{2}H_2O$.
$9NH_4Cl$, $2PbCl_2+2\frac{1}{2}H_2O$.
$10NH_4Cl$, $PbCl_2+H_2O$.
$11NH_4Cl$, $2PbCl_2+3\frac{1}{2}H_2O$.
$18NH_4Cl$, $PbCl_2+4H_2O$.

All these salts are decomp. by H_2O. (André, A. ch. (6) **3.** 104.)

Of the salts prepared by André, only one exists, NH_4Cl, $2PbCl_2$. (Wells, Sill. Am. J. **146.** 25.)

NH_4Cl, $PbCl_2+\frac{1}{2}H_2O$. (Wells, *l.c.*)

Ammonium lead *tetra*chloride.

See **Chloroplumbate, ammonium.**

Ammonium magnesium chloride, $NH_4MgCl_3+6H_2O=NH_4Cl$, $MgCl_2+6H_2O$.

Deliquescent. Very sol. in H_2O. Sol. in 6 pts. cold H_2O. (Fourcroy.)

$4NH_4Cl$, $5MgCl_2+33H_2O$. Sol. in H_2O. (Berthelot and André, A. ch. (6) **11.** 294.)

Ammonium manganous chloride, NH_4Cl, $MnCl_2+\frac{1}{2}H_2O$.

Sol. in $1\frac{1}{2}$ pts. H_2O at ordinary temp. (Hautz, A. **66.** 280); does not exist. (Saunders, Am. Ch. J. **14.** 134.)

$2NH_4Cl$, $MnCl_2+H_2O$. Sol. in H_2O (Rammelsberg); does not exist. (Saunders.)

$+2H_2O$. Easily sol. in H_2O, but with decomp. into NH_4Cl and $MnCl_2$. (Saunders.)

Ammonium mercuric chloride, $2NH_4Cl$, $HgCl_2+H_2O$ (sal alembroth).

Sol. in 0·66 pt. H_2O at 10°, and in nearly every proportion of hot H_2O.

NH_4Cl, $HgCl_2$. Easily sol. in H_2O.

$+\frac{1}{2}H_2O$. Easily sol. in H_2O. (Kane.)

$2NH_4Cl$, $3HgCl_2+4H_2O$. Easily sol. in H_2O. (Holmes, C. N. **5.** 351.)

$2NH_4Cl$, $9HgCl_2$. Sol. in H_2O. (Holmes.)

Ammonium mercuric sodium chloride, NH_4Cl, $HgCl_2$, $4NaCl$ (?).

Sol. in H_2O. (Kossmann, A. ch. (3) **27.** 243.)

Ammonium molybdenum chloride.

See **Ammonium chloromolybdenum chloride.**

Ammonium molybdenum chloride iodide.

See **Ammonium chloromolybdenum iodide.**

Ammonium nickel chloride, NH_4Cl, $NiCl_2+6H_2O$.

Deliquescent in moist air. Easily sol. in H_2O. (Hautz.)

$4NH_4Cl$, $NiCl_2+7H_2O$ (?).

Ammonium osmium *tetra*chloride.

See **Chlorosmate, ammonium.**

Ammonium osmium *sesqui*chloride.

See **Chlorosmite, ammonium.**

Ammonium palladium chlorides.

See **Chloropalladate, ammonium** *and* **chloropalladite, ammonium.**

Ammonium rhodium *di*chloride, $4NH_4Cl$, $RhCl_2+3\frac{1}{2}H_2O$.

Sol. in H_2O, but decomp. slowly. (Willm, B. **16.** 3033.)

Does not exist. (Leidié, A. ch. (6) **17.** 277.)

Ammonium rhodium *tri*chloride.

See **Chlororhodite, ammonium.**

Ammonium rhodium chloride ammonium nitrate, Rh_2Cl_6, $6NH_4Cl$, $2NH_4NO_3$.

See **Chlororhodite nitrate, ammonium.**

Ammonium ruthenium *tri*chloride.

See **Chlororuthenite, ammonium.**

Ammonium ruthenium *tetra*chloride.

See **Chlororuthenate, ammonium.**

Ammonium tellurium chloride.

See **Chlorotellurate, ammonium.**

Ammonium thallic chloride, $3NH_4Cl$, $TlCl_3$.

Easily sol. in H_2O. (Willm.)

$+2H_2O$. Easily sol. in H_2O and alcohol. (Nicklès, J. Pharm. (4) **1.** 28.)

Ammonium thorium chloride, $8NH_4Cl$, $ThCl_4+8H_2O$.

Sol. in H_2O. (Chydenius.)

Ammonium stannous chloride (ammonium chlorostannite), NH_4Cl, $SnCl_2+H_2O$.

Decomp. by H_2O. Resembles K salt. (Richardson, Am. Ch. J. **14.** 93.)

$2NH_4Cl$, $SnCl_2+H_2O$. Sol. in H_2O, but decomp. by boiling. (Rammelsberg.)

Contains $2H_2O$. (Richardson.)

$4NH_4Cl$, $SnCl_2+3H_2O$. Decomp. by H_2O. (Poggiale, C. R. **20.** 1182.)

Does not exist. (Richardson.)

Ammonium stannic chloride.

See **Chlorostannate, ammonium.**

Ammonium titanium chloride, $3NH_4Cl$, $TiCl_4$.

Sol. in H_2O.

$6NH_4Cl$, $TiCl_4$. Sol. in H_2O. (Rose.)

Ammonium uranyl chloride.

Very deliquescent, and sol. in H_2O. (Peligot.)

Ammonium zinc chloride, $NH_4Cl, ZnCl_2+2H_2O$.

Deliquescent. Very sol. in H_2O. (Hautz, A. **66.** 287.)

$2NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Rammelsberg, Pogg. **94.** 507.)

$+H_2O$. Deliquescent in moist air. Sol. in $\frac{2}{3}$ pt. cold H_2O with absorption of heat. Sol. in 0·28 pt. hot H_2O (Golfier-Bassayre, A. ch. **70.** 344); sol. in $\frac{1}{2}$ pt. cold H_2O. (Hautz, A. **66.** 287.)

$3NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Marignac.)

$+H_2O$. (Berthelot, A. ch. (6) **11.** 294.)

$4NH_4Cl$, $ZnCl_2$. (Dehérain.)

$6NH_4Cl$, $ZnCl_2+\frac{2}{3}H_2O$. (Berthelot, *l.c.*)

Ammonium chloride zinc oxychloride, $2ZnCl_2$, $8NH_4Cl$, ZnO.

Sol. in a little H_2O, but decomp. by excess. (André.)

$3ZnCl_2$, $10NH_4Cl$, ZnO. As above. (André, A. ch. (6) **3.** 88.)

Ammonium chloride antimony fluoride, NH_4Cl, SbF_3.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Ammonium chloride arsenic *tri*oxide.

See **Arsenite chloride, ammonium.**

Ammonium chloride bismuth bromide, $3NH_4Cl$, $BiBr_3+H_2O$.

Deliquescent; decomp. by H_2O. (Muir, Chem. Soc. **31.** 148.)

$2NH_4Cl$, $BiBr_3+3H_2O$. Decomp. by H_2O. (Muir.)

$5NH_4Cl$, $2BiBr_3+H_2O$. Decomp. by H_2O. (Muir.)

Ammonium chloride cuprocupric thiosulphate, $2NH_4Cl$, Cu_2O, CuO, $3S_2O_2$.

See **Thiosulphate ammonium chloride, cuprocupric.**

Ammonium chloride lead iodide, $3NH_4Cl$, PbI_2.

Decomp. with H_2O. (Behrens, Pogg. **62.** 252.)

$4NH_4Cl$, PbI_2+2H_2O. Decomp. with H_2O. (Poggiale, C. R. **20.** 1180.)

Ammonium chloride platinum sulphite.

See **Chloroplatosulphite, ammonium.**

Ammonium chloride stannous bromide, $2NH_4Cl$, $SnBr_2+H_2O$.

Sol. in H_2O. (Raymann and Preis, A. **223.** 323.)

Ammonium fluoride, NH_4F.

Abundantly sol. in H_2O; sl. sol. in alcohol. (Marignac, Ann. Min. (5) **15.** 221.)

Ammonium hydrogen fluoride, NH_4F, HF.

Deliquescent in moist air. Sol. in H_2O.

Ammonium antimony fluoride, $2NH_4F$, SbF_3.

Deliquescent; sol. in 0·9 pt. cold H_2O.

Insol. in alcohol or ether. (Flückinger, A. **84**. 248.)

NH_4F, SbF_5. Easily sol. in H_2O. (Marignac, A. **145**. 239.)

Ammonium bismuth fluoride, $2NH_4F$, BiF_3.

Insol. in H_2O. Rather difficultly sol. in acids. (Helmholt, Z. anorg. **3**. 115.)

Ammonium cadmium fluoride, NH_4F, CdF_2.

Insol. in H_2O. Sol. in acids on boiling. (Helmholt, Z. anorg. **3**. 115.)

Ammonium chromium fluoride, $3NH_4F$, CrF_3.

Easily sol. in H_2O. Sl. sol. in NH_4F+Aq. (Petersen, J. pr. (2) **40**. 52.)

$2NH_4F$, CrF_3+H_2O. (Wagner, B. **19**. 896.)

Ammonium cobaltous fluoride, $2NH_4F$, CoF_2+2H_2O.

Sl. sol. in H_2O. (Wagner, B. **19**. 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3**. 132.)

Ammonium columbyl fluoride.

See **Fluoxycolumbate, ammonium.**

Ammonium columbium fluoride oxyfluoride, $3NH_4F$, NbF_5, $NbOF_3$.

See **Fluoxycolumbate columbium fluoride, ammonium.**

Ammonium copper fluoride, $2NH_4F$, CuF_2+2H_2O.

Insol. in H_2O. (Helmholt, Z. anorg. **3**. 115.)

Ammonium glucinum fluoride, $2NH_4F$, GlF_2.

Sol. in H_2O. (Marignac, A. ch. (4) **30**. 51.)

Very sol. in H_2O. (Helmholt, Z. anorg. **3**. 130.)

Ammonium ferrous fluoride, $2NH_4F$, FeF_2.

(Wagner, B. **19**. 896.)

NH_4F, FeF_2+2H_2O. (W.)

Ammonium ferric fluoride, $2NH_4F$, FeF_3.

More sol. in H_2O than the corresponding K compound. Decomp. by boiling. (Ncklès, J. Pharm. (4) **7**. 15.)

$3NH_4F$, FeF_3. Sl. sol. in H_2O. (Marignac, A. ch. (3) **60**. 306.)

Easily sol. in acids. (Helmholt, Z. anorg. **3**. 124.)

Ammonium manganic fluoride, $2NH_4F$, MnF_4.

More sol. than the K salt. (Nicklès, C. R. **65**. 107.)

True composition is $4NH_4F$, Mn_2F_6. (Christensen, J. pr. (2) **34**. 41.)

See **Fluomanganate, ammonium.**

Ammonium manganyl fluoride.

See **Fluoxymanganate, ammonium.**

Ammonium molybdenum fluoride.

Insol. in H_2O. Sol. in $HCl+Aq$. (Berzelius.)

See **Fluomolybdate, ammonium.**

Ammonium molybdenyl fluoride.

See **Fluoxymolybdate, ammonium.**

Ammonium nickel fluoride, $2NH_4F$, NiF_2+2H_2O.

Sol. in H_2O. (Wagner, B. **19**. 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3**. 143.)

Ammonium silicon fluoride.

See **Fluosilicate, ammonium.**

Ammonium tantalum fluoride.

See **Fluotantalate, ammonium.**

Ammonium tantalyl fluoride.

See **Fluoxytantalate, ammonium.**

Ammonium tellurium fluoride, NH_4F, TeF_4.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35**. 60.)

Ammonium stannous fluoride, $2NH_4F$, SnF_2+2H_2O.

Sol. in H_2O. (Wagner, B. **19**. 896.)

Ammonium stannic fluoride, $2NH_4F$, SnF_4.

See **Fluostannate, ammonium.**

Ammonium titanium *sesqui*fluoride.

See **Fluotitanate, ammonium.**

Ammonium titanyl fluoride.

See **Fluoxypertitanate, ammonium.**

Ammonium tungstyl fluoride.

See **Fluoxytungstate, ammonium.**

Ammonium uranyl fluoride.

See **Fluoxyuranate, ammonium.**

Ammonium fluoride manganic oxyfluoride, $2NH_4F$, $MnOF_2$.

Precipitate. (Nicklès.)

See also **Fluoxymanganate, ammonium.**

Ammonium fluoride molybdenum *tri*oxide, $2NH_4F$, MoO_3.

Decomp. by H_2O. (Mauro, Gazz. ch. it. **18**. 120.)

Ammonium vanadium *sesqui*fluoride.

See **Fluovanadate, ammonium.**

Ammonium vanadyl fluoride.

See **Fluoxyvanadate, ammonium.**

Ammonium zinc fluoride, $2NH_4F$, ZnF_2.

Sol. in H_2O. (R. Wagner.)

$+2H_2O$. Very sl. sol. in H_2O. Easily sol. in dil. acids. (Helmholt.)

Ammonium zirconium fluoride.

See **Fluozirconate, ammonium.**

Ammonium fluoride tungsten oxyfluoride.

See **Fluoxytungstate, ammonium.**

Ammonium fluoride tungsten oxyfluoride ammonium tungstate, $4NH_4F$, WO_2F_2, $(NH_4)_2WO_4$.

See **Fluoxytungstate tungstate, ammonium.**

Ammonium fluoride vanadium oxyfluoride.

See **Fluoxyvanadate,** *and* **fluoxyhypovar date, ammonium.**

Ammonium hydroselenide, NH_4HSe.

Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)

Ammonium hydrosulphide, NH_4SH.

Sol. in H_2O and alcohol. Solutions decomp. on air.

Ammonium hydroxide, NH_4OH.

See **Ammonia,** NH_3.

Ammonium iodide, NH_4I.

Very deliquescent. Sol. in 0·60 pt. H_2O. (Eder, Dingl. **221.** 89.)

Sp. gr. of aqueous solution of NH_4I at 18° containing—

10	20	30	40	50 % NH_4I.
1·0652	1·1397	1·2260	1·3260	1·4415

(Kohlrausch, W. Ann. **1879.** 1.)

Sol. in 4·0 pts. abs. alcohol. (Eder, *l.c.*)
,, 210 ,, ether. (Eder, *l.c.*)
,, 20 ,, alcohol-ether (1 : 1). (Eder, *l.c.*)

Ammonium *di***iodide,** NH_4I_2.

Sol. in alcohol, ether, CS_2, and KI + Aq ; less sol. in chloroform. (Guthrie, Chem. Soc. (2) **1.** 239.)

Ammonium *tri***iodide,** NH_4I_3.

Sl. deliquescent. Sol. in little H_2O, but decomp. by much H_2O. (Johnson, Chem. Soc. **33.** 397.)

Ammonium antimony iodide, NH_4I, SbI_3+2H_2O.

Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$3NH_4I, 4SbI_3+9H_2O$. Decomp. by H_2O, with separation of SbOI. Sol. in $HC_2H_3O_2$, HCl, and $H_2C_4H_4O_6$ + Aq. Decomp. by CS_2. (Schäffer, Pogg. **109.** 611.)
$3NH_4I, SbI_3+3H_2O$. As above.
$4NH_4I, SbI_3+3H_2O$. As above.

Ammonium bismuth iodide, NH_4I, BiI_3+H_2O.

Deliquescent ; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)
$4NH_4I, BiI_3+3H_2O$. As above. (Linau, Pogg. **111.** 240.)

$2NH_4I, BiI_3+2\frac{1}{2}H_2O$. Decomp. by H_2O, or MCl, MBr, or MI + Aq. (Nicklès, J. pr. (2) **39.** 116.)

Ammonium cadmium iodide, $2NH_4I, CdI_2+2H_2O$.

Deliquescent. (Croft.)
Sol. at 15° in 0·58 pt. H_2O, 0·70 pt. abs. alcohol, 8·9 pts. ether (sp. gr. 0·729), and 1·8 pts. alcohol-ether (1 : 1). (Eder, Dingl. **221.** 89.)
$NH_4I, CdI_2+\frac{1}{2}H_2O$. Sol. at 15° in 0·90 pt. H_2O, 0·88 pt. abs. alcohol, and 2·4 pts. ether (sp. gr. 0·729). (Eder, *l.c.*)

Ammonium chloromolybdenum iodide, $2NH_4I, Cl_4Mo_3I_2+2H_2O$.

Decomp. by H_2O. Cryst. from HI + Aq. (Blomstrand.)

Ammonium cuprous iodide, $2NH_4I, Cu_2I_2+H_2O$.

Decomp. on the air, or by H_2O, or alcohol. (Saglier, C. R. **104.** 1440.)

Ammonium cupric iodide ammonia, $2NH_4I, CuI_2, 2NH_3+2H_2O$.

Insol. in H_2O or alcohol ; sl. sol. in NH_4OH + Aq.
$+6H_2O$. Unstable. (Saglier, C. R. **104.** 1440.)
$2NH_4I_2, CuI_2, 2NH_3+2H_2O$. Decomp. by H_2O ; sl. sol. in NH_4OH + Aq. (Saglier.)

Ammonium iridium *di***iodide,** $2NH_4I, IrI_2$.

Insol. in cold or hot H_2O, and in alcohol. Sol. in warm dil. acids. (Oppler.)

Ammonium iridium *sesqui***iodide.**

See **Iodiridite, ammonium.**

Ammonium iridium *tetra***iodide.**

See **Iodiridate, ammonium.**

Ammonium lead iodide, NH_4I, PbI_2+2H_2O.

Decomp. by much H_2O. (Wells, Sill. Am. J. **146.** 25.)

Ammonium magnesium iodide, NH_4I, MgI_2+6H_2O.

Very deliquescent. (Lerch, J. pr. (2) **28.** 338.)

Ammonium mercuric iodide, NH_4I, HgI_2+H_2O.

Decomp. into its constituents by H_2O. (Boullay, A. ch. (2) **34.** 345.)
Sol. without decomp. in alcohol and ether.

Ammonium silver iodide, $2NH_4I, AgI$.

Deliquescent. Decomp. by H_2O. (Poggiale.)

Ammonium thallic iodide, NH_4I, TlI_3.

Sol. in H_2O. (Nicklès, J. Pharm. (4) **1.** 32.)

Ammonium stannous iodide, NH_4I, SnI_2.

Decomp. by small amt. H_2O, but completely sol. in a large amt. (Boullay, A. ch. (2) **34.** 376.)
$+1\frac{1}{2}H_2O$. (Personne.)

Ammonium zinc iodide, $2NH_4I, ZnI_2$.

Extremely deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. **43.** 665.)

Ammonium iodide arsenic *tri***oxide.**

See **Arsenite iodide, ammonium.**

Ammonium selenide, $(NH_4)_2Se$.

Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)

Ammonium hydrogen selenide, NH_4HSe.

Sol. in H_2O. (Fabre, C. R. **103.** 269.)

Ammonium sulphide, basic, $(NH_4)_2S, 4NH_3$ (?).

Sol. in H_2O with decomp. (Maumené, C. R. **89.** 506.)

Ammonium *mono***sulphide,** $(NH_4)_2S$.

Decomp. on air. Sol. in H_2O, but solution decomposes rapidly.

Ammonium *di***sulphide,** $(NH_4)_2S_2$.

Sol. in H_2O with decomp.

Ammonium *tetra*sulphide, $(NH_4)_2S_4$.

Easily sol. in H_2O. Conc. solution is stable, dil. solution decomp. on air. Easily sol. in alcohol without decomp., but solution decomp. on the air more rapidly than the aqueous solution. (Fritzsche, J. pr. **32.** 313.)

Ammonium *penta*sulphide, $(NH_4)_2S_5$.

Decomp. on air. Sol. in H_2O with separation of S. Sol. in alcohol without decomp., but solution decomposes quickly on standing. (Fritzsche, J. pr. **32.** 313.)

Ammonium *hepta*sulphide, $(NH_4)_2S_7$.

More stable on air, and less easily decomposed by H_2O than $(NH_4)_2S_5$.

Ammonium copper sulphide, $(NH_4)_2S, 2CuS_3$ (?).

Sol. in warm H_2O, but decomp. on standing. Warm KOH + Aq acts similarly; sl. sol. in NH_4OH + Aq, Na_2CO_3 + Aq, or absolute alcohol. Insol. in ether. Decomp. by dil. acids. (Priwoznik, B. **6.** 1291.)

Ammonium stannic sulphide.

See **Sulphostannate, ammonium.**

Ammonium telluride, NH_4HTe.

Easily sol. in H_2O. (Bineau, A. ch. (2) **67.** 229.)

Ammonplatin*di*amine comps.

See **Platin*tri*amine comps.**

Ammon*di*sulphonic acid, $NH_3(SO_3H)_2$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is identical with imidosulphonic acid $NH(SO_3H)_2$, which see. (Raschig, A. **241.** 161.)

Ammon*tri*sulphonic acid, $NH_2(SO_3H)_3$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is nitrilosulphonic acid $N(SO_3H)_3$, which see. (Raschig, A. **241.** 161.)

Ammon*tetra*sulphonic acid, $NH(SO_3H)_4$.

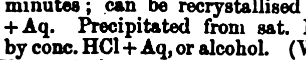
Known only in its salts. (Claus, A. **158.** 52 and 194.)

Does not exist, but was impure nitrilosulphonic acid, which see. (Raschig, A. **241.** 161.)

Anhydroarseniotungstic acid, $H_3AsW_8O_{28}$.

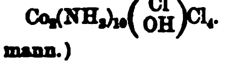
See under **Arseniotungstic acid.**

Anhydrooxycobaltamine chloride,



$$Co_2(NH_3)_{10}\begin{bmatrix}Cl\\O(OH)\end{bmatrix}Cl_4 + H_2O.$$

Easily sol. in H_2O, but decomposes after a few minutes; can be recrystallised from dil. HCl + Aq. Precipitated from sat. H_2O solution by conc. HCl + Aq, or alcohol. (Vortmann, M. Ch. **6.** 404.)



$Co_2(NH_3)_{10}\begin{pmatrix}Cl\\OH\end{pmatrix}Cl_4$. Sol. in H_2O. (Vortmann.)

Anhydrooxycobaltamine chloride mercuric chloride, $Co_2(NH_3)_{10}(ClO_2H)Cl_4, 3HgCl_2$.

Can be recryst. from very dil. hot HCl + Aq.

—— **chloroplatinate,** $Co_2(NH_3)_{10}(ClO_2H)Cl_4, 2PtCl_4$.

Can be recrystallised from H_2O containing HCl.

—— **chloronitrate,** $Co_2(NH_3)_{10}Cl(O.OH)(NO_3)_4 + H_2O$.

Can be recrystallised from dil. HCl + Aq.

$Co_2(NH_3)_{10}Cl(O.OH)Cl_2(NO_3)_2 + H_2O$. More easily sol. in H_2O than the preceding comp.

—— **chlorosulphate,** $Co_2(NH_3)_{10}Cl(O.OH)(SO_4)_2$.

—— ***di*chromate,** $[Co_2(NH_3)_{10}O.OH]_2(Cr_2O_7)_5 + 8H_2O$.

Sl. sol. in H_2O.

—— **nitrate,** $Co_2(NH_3)_{10}(NO_3)(O.OH)(NO_3)_4 + H_2O$.

Sl. sol. in pure H_2O with immediate decomp. Can be recrystallised from H_2O containing HNO_3.

—— **sulphate,** $[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5, 2H_2SO_4 + 2H_2O$.

Sl. sol. in cold H_2O. When crystallised from dil. H_2SO_4 + Aq, is converted into—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5, H_2SO_4 + 3H_2O$, which by further recrystallisation from very dil. H_2SO_4 + Aq becomes—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5 + 8H_2O$. Sl. sol. in cold H_2O. (Vortmann.)

Anhydrophospholuteotungstic acid, $H_3PW_8O_{28}$.

See under **Phosphotungstic acid.**

Antimonic Acid.

$HSbO_3$. Very sl. sol. in H_2O; sol. in conc. HCl + Aq; sl. sol. in dil. HNO_3 + Aq; easily sol. in tartaric acid + Aq; easily sol. in hot KOH, or NaOH + Aq; completely insol. in NH_4OH + Aq. (Fremy, A. ch. (3) **23.** 407.)

$H_4Sb_2O_7 + 2H_2O$. More sol. in H_2O and acids than H_3SbO_4. Sol. in cold NH_4OH, or KOH + Aq. (Fremy.)

H_3SbO_4. Sl. sol. in H_2O. Insol. in NH_4OH + Aq. Easily sol. in KOH + Aq. (Fremy.)

Does not exist. (Raschig, B. **18.** 2745.)

Has, however, been prepared by Daubrawa (A. **186.** 110), Conrad (C. N. **40.** 198), and Beilstein and Blaese (Bull. Ac. St. Petersb. **33.** 97).

$+ \frac{1}{2}H_2O$. (Beilstein and Blaese.)

According to Beilstein and Blaese only one antimonic acid, H_3SbO_4, exists.

Antimonates.

α. *Antimonates. From* $HSbO_3$. Some of the K and NH_4 salts are sol. in H_2O, the others are slightly sol. or insol.

β. *Pyroantimonates. From* $H_4Sb_2O_7$. As a class, insol. in H_2O, but decomp. thereby except in presence of large excess of alkali. (Fremy, A. ch. (3) **12.** 499.)

Probably do not exist. (Beilstein and Blaese.)

Aluminum antimonate, Al_2O_3, $3Sb_2O_5$ (?).

Ppt. Somewhat sol. in excess of Al salts + Aq. Insol. in $K_4Sb_2O_7$ + Aq.

$Al(SbO_3)_3 + 15H_2O = AlH_6(SbO_4)_3 + 12H_2O$. Ppt. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 101.)

$Al(SbO_3)_3 + 7H_2O = AlH_6(SbO_4)_3 + 4H_2O$. Ppt. (B. and B.)

Al_2O_3, $Sb_2O_5 + 9H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Ammonium antimonate, $NH_4SbO_3 + 2H_2O$.

Insol. in H_2O.

$+ 6H_2O$. *See* $(NH_4)_2H_2Sb_2O_7 + 5H_2O$.

Ammonium *pyro***antimonate,** $(NH_4)_4Sb_2O_7$.

Known only in solution.

$(NH_4)_2H_2Sb_2O_7 + 5H_2O$.

Sol. in H_2O, but decomp. by standing or boiling into insol. salt. Insol. in alcohol (Fremy, J. pr. **45.** 215). Composition is $NH_4SbO_3 + 6H_2O$, according to Raschig (B. **18.** 2743).

Barium antimonate, $Ba(SbO_3)_2$.

Ppt. Scarcely sol. in H_2O. Slowly sol. in $BaCl_2$ + Aq.

+5, or $6H_2O$. Ppt.

Bismuth antimonate, $BiSbO_4 + H_2O$.

Ppt. Insol. in H_2O; sol. in HCl + Aq. (Cavazzi, Gazz. ch. it. **15.** 37.)

$3Bi_2O_3$, $Sb_2O_5 + H_2O$. Insol. in H_2O; sol. in HCl + Aq. (Cavazzi.)

$2Bi_2O_3$, Sb_2O_5. As above. (Cavazzi.)

Cadmium antimonate, $Cd(SbO_3)_2 + 6H_2O$.

Ppt. (Ebel, B. **22.** 3043.)

Calcium antimonate, $Ca(SbO_3)_2$.

Ppt.

$+ 5H_2O$. Ppt. (Heffter, Pogg. **86.** 418.)

$3CaO$, $2Sb_2O_5 + 6H_2O$. Min. *Ullmanite.*

Chromic antimonate, $Cr(SbO_3)_3 + 14H_2O$.

Ppt. (Beilstein and Blaese.)

Cobaltous antimonate, $Co(SbO_3)_2 + 7H_2O$.

Sl. sol. in H_2O. Sl. sol. in boiling solutions of cobalt salts.

$+ 12H_2O$. Ppt. (Heffter, Pogg. **86.** 448.)

$+ 6H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Cupric antimonate, $Cu(SbO_3)_2$.

Insol. in H_2O, acids, or alkalies. (Berzelius.)

$+ 5H_2O$. Ppt. (Ebel, B. **22.** 3043.)

$3CuO$, $2Sb_2O_5$. Ppt. (Beilstein and Blaese.)

Cupric antimonate ammonia, $Cu(SbO_3)_2$, $4NH_3 + 4H_2O$.

Insol. in H_2O and NH_4OH + Aq. (Schiff, A. **123.** 39.)

$CuSb_2N_3H_{21}O_{12} = Cu(ONH_4)OH, 2(NH_4SbO_3 + 2H_2O)$. (Raschig, B. **18.** 2743.)

Glucinum antimonate, $Gl(SbO_3)_2 + 6H_2O$.

Ppt. (Ebel, B. **22.** 3043.)

Ferrous antimonate.

Sl. sol. in H_2O. (Berzelius.)

Ferric antimonate.

Insol. in H_2O. (B.)

Fe_2O_3, $Sb_2O_5 + 7H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Fe_2O_3, $2Sb_2O_5 + 11H_2O$. Ppt. (Beilstein and Blaese.)

$Fe(SbO_3)_3 + 6\frac{1}{2}H_2O$. Ppt. (B. and B.)

Lead antimonate, basic, $Pb_3(SbO_3)_2(OH)_4 + 2H_2O = Pb_3(SbO_4)_2 + 4H_2O$.

Min. *Bleinerite, Bindheimite.*

$2Pb(SbO_3)_2$, $PbO + 11H_2O$. Ppt. (B. and B.)

Lead antimonate, $Pb(SbO_3)_2$.

Insol. in H_2O. Incompletely decomp. by acids. (Berzelius.)

Naples Yellow. Insol. in H_2O.

$+ 5H_2O$. Ppt. (Ebel, B. **22.** 3043.)

$Pb(SbO_3)_2 + 6H_2O$. Ppt. (Beilstein and Blaese.)

Lead antimonate chloride, $Pb(SbO_3)_2$, $PbCl_2$.

Min. *Nadorite.* Sol. in HCl, HNO_3, and tartaric acid + Aq.

Lithium antimonate, $LiSbO_3$.

Sl. sol. in cold, sol. in hot H_2O, and crystallises on cooling. Much more sol. than $NaSbO_3$.

$+ 3H_2O$. Ppt. Sl. sol. in H_2O. (Beilstein and Blaese.)

Magnesium antimonate, $Mg(SbO_3)_2 + 12H_2O$.

Sol. in hot, less sol. in cold H_2O. (Heffter.)

Sol. in $MgSO_4$ + Aq; insol. in $KSbO_3$ + Aq. (Berzelius.)

Manganous antimonate, $Mn(SbO_3)_2$.

Difficultly sol. in H_2O.

When heated, is sol. only in strong acids.

$+ 5H_2O$. Ppt. (Ebel, B. **22.** 3043.)

$+ 7H_2O$. Ppt. (Beilstein and Blaese.)

Mercurous antimonate.

Insol. in H_2O. (Berzelius.)

Mercuric antimonate.

Insol. in H_2O, alkalies, and most acids.

Sl. attacked by boiling H_2SO_4, and HCl + Aq.

$Hg(SbO_3)_2 + 6H_2O$. Ppt. (Beilstein and Blaese.)

Nickel antimonate, $Ni(SbO_3)_2 + 6H_2O$.

Ppt. Insol. in H_2O. (Heffter, Pogg. **86.** 446.)

$+ 12H_2O$. Sl. sol. in H_2O. (Heffter.)

Potassium antimonate, $KSbO_3$.

Insol. in H_2O. Sol. in warm KOH + Aq, but separates nearly completely on cooling. By boiling with H_2O, or by standing for a long time with cold H_2O, it gradually dissolves as $2KSbO_3 + 5H_2O$, or $K_2H_2Sb_2O_7 + 4H_2O$, or $2KH_2SbO_4 + 3H_2O$.

$2KSbO_3 + 3H_2O$ ($= 2KSbO_3 + 5H_2O$ of Fremy). Easily sol. in H_2O, especially if warm. Solution is pptd. by NH_4Cl + Aq. (Fremy, A. ch. (3) **12.** 499.)

$2KSbO_3 + 5H_2O$. 100 pts. H_2O at 20° dissolve 2·81 pts. anhydrous salt; sp. gr. of solution sat. at 18° = 1·0263. Composition is given as $K_2H_2Sb_2O_7 + 4H_2O$. (Knorre and Olschewsky, B. **20.** 3043.)

Potassium *pyro*antimonate, $K_4Sb_2O_7$.

Deliquescent; decomp. by boiling with H_2O into $KSbO_3+5H_2O$, by cold H_2O into $K_2H_2Sb_2O_7+6H_2O$. (Fremy.)

Does not exist. (Knorre and Olschewsky.)

Potassium hydrogen antimonate, $2K_2O, 3Sb_2O_5+7H_2O$.

Very difficultly sol. in hot or cold H_2O. (Knorre and Olschewsky, B. **18.** 2358.)

$2KH(SbO_3)_2+5H_2O$, or $2KH_3Sb_2O_7+3H_2O$. Ppt.

Potassium hydrogen *pyro*antimonate, $K_2H_2Sb_2O_7+6H_2O$.

Quite difficultly sol. in cold H_2O. Not precipitated by NH_4Cl+Aq. Aqueous solution gradually decomposes. (Fremy.)

$+4H_2O$. *See* $2KSbO_3+5H_2O$.

Potassium antimonate sulphantimonate, $KSbO_3, K_3SbS_4+5H_2O$.

Decomp. on air, and with cold H_2O. Sol. in hot H_2O. (Rammelsberg.)

Silver antimonate.

Insol. in H_2O. (Berzelius.)

$AgSbO_3+3H_2O=AgH_2SbO_4+2H_2O$. Easily sol. in NH_4OH+Aq, when freshly pptd. (Beilstein and Blaese.)

$+1\frac{1}{2}H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Silver antimonate ammonia, $AgH_2SbO_4, 2NH_3+H_2O$.

(Beilstein and Blaese.)

Sodium antimonate, $NaSbO_3$.

Sol. in much H_2O, but soon becomes decomp. into $Na_2H_2Sb_2O_7$.

$+3\frac{1}{2}H_2O$, composition of $Na_2H_2Sb_2O_7+6H_2O$, according to Beilstein and Blaese.

1000 pts. H_2O dissolve 0·31 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12·3°.

1000 pts. alcohol of 15·8 % dissolve 0·13 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12·3°.

1000 pts. alcohol of 25·6 % dissolve 0·07 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12·3°.

Somewhat more sol. when freshly precipitated.

Absolutely insol. in glacial $HC_2H_3O_2$.

Presence of NaOH or Na salts diminish solubility, while NH_4OH or K salts increase it slightly. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 201.)

Sodium *pyro*antimonate, $Na_2H_2Sb_2O_7+6H_2O$.

Boiling H_2O dissolves $\frac{1}{350}$ pt. of this salt. (Fremy.) 1000 pts. H_2O dissolve 2·5 pts. salt. (Ebel, B. **22.** 3044.) *See also* $NaSbO_3+3\frac{1}{2}H_2O$.

$+5H_2O$. (Knorre and Olschewsky.)

Strontium antimonate, $Sr(SbO_3)_2+6H_2O$.

Ppt. Less sol. in H_2O than $SrSO_4$. (Heffter, Pogg. **86.** 418.)

Thallous antimonate, $TlSbO_3+2H_2O=TlH_2SbO_4+H_2O$.

Somewhat sol. in H_2O, when freshly precipitated; insol. when dried. (Beilstein and Blaese.)

Stannous antimonate, $2SnO, Sb_2O_5$.

Ppt. (Lenssen, A. **114.** 113.)

$Sn(SbO_3)_2+2H_2O$. Attacked with difficulty by acids or alkalies, most easily by hot conc. H_2SO_4. (Schiff, A. **120.** 55.)

$2SnO, 3Sb_2O_5+4H_2O$.

$SnO, 2Sb_2O_5$.

Stannic antimonate.

Insol. in H_2O. (Levol, A. ch. (3) **1.** 504.)

Uranium antimonate, $5UO_2, 3Sb_2O_5+15H_2O$.

Ppt. Sol. in hot conc. HCl+Aq, and in UCl_3+Aq. (Rammelsberg.)

Zinc antimonate, $Zn(SbO_3)_2$.

Very slightly sol. in H_2O (Berzelius); sol. in solutions of Zn salts.

$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Antimoniomolybdic acid.

Ammonium antimoniomolybdate, $5(NH_4)_2O, 4Sb_2O_5, 7MoO_3+12H_2O$.

Readily sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniotungstic acid.

Potassium antimoniotungstate, $6K_2O, 4Sb_2O_5, 12WO_3+25H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniuretted hydrogen.

See **Antimony hydride.**

Antimonosomolybdic acid.

Ammonium antimonosomolybdate, $6(NH_4)_2O, 3Sb_2O_3, 17MoO_3+21H_2O$.

Insol. in cold H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonosophosphotungstic acid.

Potassium antimonosophosphotungstate, $12K_2O, 5Sb_2O_3, 6P_2O_5, 22WO_3+48H_2O$.

Nearly insol. in cold or warm H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimonosotungstic acid.

Ammonium antimonosotungstate.

Sol. in H_2O.

Barium antimonosotungstate, $4BaO, 6Sb_2O_3, 22WO_3+36H_2O$.

Precipitate; very sl. sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonous acid, $HSbO_2+1\frac{1}{2}H_2O$.

Ppt. (Schaffner, A. **51.** 182.)

H_3SbO_3. Ppt. (Clarke and Stallo, B. **13.** 1793.)

Does not exist. (Guntz, C. R. **102.** 1472.)

$H_4Sb_2O_5$. When freshly pptd., is sol. in dil. KOH, and NaOH+Aq. Scarcely sol. in NH_4OH+Aq, or in $(NH_4)_2CO_3$, or $KHCO_3$+Aq.

Completely sol. in K_2CO_3, and Na_2CO_3+Aq, especially if warm. When recently pptd. is sl. sol. in succinic acid+Aq.

Calcium antimonite, $CaSb_2O_4$ (?).

Min. *Romeite.* Insol. in acids.

Cobaltous antimonite (?).

Sl. sol. in H_2O. (Berzelius.)

Cuprous antimonite, $Cu_6(SbO_3)_2$.

Insol. in H_2O. Sol. in acids; most easily in conc. HCl+Aq. (Hausmann and Stromeyer, Schw. J. **19.** 241.)

Cupric antimonite (?).

Insol. in H_2O. (Berzelius.)

$CuSb_2O_5$. Min. *Ammiolite.*

Ferrous antimonite (?).

More sol. in H_2O than the antimonate. (Dumas.)

Potassium antimonite, K_2O, $3Sb_2O_3$.

Easily decomp. by cold H_2O. Not decomp. by KOH+Aq containing over 20·9 % K_2O. (Corimimbœuf, C. R. **115.** 1305.)

$+3H_2O$. As above. (C.)

Sodium antimonite, $NaSbO_2+3H_2O$.

Difficultly sol. in H_2O. (Terreil, A. ch. (4) **7.** 380.)

$2Na_2O$, $3Sb_2O_3+H_2O$. Decomp. by H_2O, but not by NaOH+Aq containing 94·3 g. NaOH per l. (Corimimbœuf.)

Na_2O, $2Sb_2O_3$. Decomp. by H_2O but not by NaOH+Aq containing 188·6 g. NaOH per l. (C.)

Na_2O, $3Sb_2O_3$. Decomp. by H_2O, but not by NaOH+Aq containing 113·2 g. NaOH per l. (C.)

$+2H_2O=NaH_2(SbO_2)_3$. (Terreil.)

Antimony, Sb.

Does not decomp. H_2O. Not attacked by HCl+Aq (Berzelius); slowly sol. in conc. HCl+Aq (Debray); slowly sol. in conc. warm HCl+Aq (Troost). Attacked by very conc. HCl+Aq only when finely divided (Schützenberger, Willm); very sl. attacked by dil. or conc. acid (Guntz). Not attacked by boiling HCl+Aq (Gmelin). By careful experiments, pure Sb is absolutely insol. in dil. or conc., hot or cold HCl+Aq, except when in contact with oxygen. (Ditte and Metzner, A. ch. (6) **29.** 889.)

Insol. in dil. or cold conc., but sol. in hot conc. H_2SO_4. Oxidised but not dissolved by HNO_3+Aq. Easily and completely sol. in aqua regia.

Very slowly attacked by pure HNO_3+Aq of 1·51-1·42 sp. gr.; weaker acid has no marked action whether it contains NO_2 or not. HCl+HNO_3 has no action if dil. or at low temp., but when even very dil. and KNO_2 is added, the action will begin. (Millon, A. ch. (3) **6.** 101.)

Not attacked in 10 months by 2 % HNO_3+Aq. Sb is not dissolved by HNO_3+Aq of any concentration, a white powder being always left, which is insol. in HNO_3+Aq or H_2O. (Montemartini, Gazz. ch. it. **22.** 384.)

Insol. in alkalies+Aq.

Easily attacked by pyrosulphuryl chloride. (Heumann and Köchlin, B. **16.** 479.)

Antimony arsenide, Sb_3As.

(Descamps, C. R. **86.** 1065.)

Antimony *tri*bromide, $SbBr_3$.

Deliquescent; decomp. by H_2O.

Sol. in alcohol and CS_2.

Antimony rubidium bromide, $2SbBr_3$, $3RbBr$.

Decomp. by H_2O; can be recryst. from dil. HBr+Aq. (Wheeler, Z. anorg. **5.** 258.)

$10SbBr_3$, $23RbBr$ (?). Cryst. from conc. HBr+Aq. (Wheeler.)

Antimony bromide potassium chloride, $SbBr_3$, $3KCl+1\frac{1}{2}H_2O=SbCl_3K_3Br_3+1\frac{1}{2}H_2O$.

Slowly deliquescent. Very sol. in H_2O.

Sat. solution contains 120·5 g. to 100 ccm. H_2O, and has sp. gr. =1·9.

Decomp. by much H_2O. (Atkinson, Chem. Soc. **43.** 290.)

See also **Antimony chloride potassium bromide.**

Antimony *tri*chloride, $SbCl_3$.

Deliquescent. Decomp. by H_2O with precipitation of SbOCl. This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc. solutions of chlorides of alkalies and alkaline earths.

Sol. in alcohol without decomp. Very sol. in hot CS_2, but solubility diminishes rapidly on cooling. (Cooke, Proc. Am. Acad. **13.** 72.)

Antimony hydrogen chloride, $2SbCl_3$, $HCl+2H_2O$.

Deliquescent. Decomp. by H_2O.

Melts in crystal H_2O at 16°. (Engel, C. R. **106.** 1797.)

Antimony *penta*chloride, $SbCl_5$.

Deliquesces to $SbCl_5+4H_2O$, which can be crystallised out of a little H_2O. Decomp. by more H_2O into SbO_2Cl. Sol. in a large amt. of H_2O, if it is added all at one time. Precipitation by H_2O is also hindered by presence of tartaric, or hydrochloric acid.

$+H_2O$. Deliquescent. Sol. in chloroform. (Anschütz and Evans, A. **239.** 285.)

$+4H_2O$. Insol. in chloroform. (Anschütz and Evans.)

Antimony hydrogen *penta*chloride, $SbCl_5$, $5HCl+10H_2O$.

Not deliquescent. Decomp. by H_2O. Melts in crystal H_2O at about 55°. (Engel, C. R. **106.** 1797.)

Antimony antimonyl potassium chloride, $SbCl_3$, $SbOCl$, $2KCl$.

Not deliquescent. Immediately decomp. by hot or cold H_2O; sol. in hot glacial $HC_2H_3O_2$, or in HCl, or tartaric acid+Aq.

Insol. in KCl+Aq, hot or cold alcohol, CS_2, or ligroine. (Benedikt, Proc. Am. Acad. **29.** 217.)

Antimony barium chloride, $BaCl_2$, $SbCl_3+\frac{5}{2}H_2O$.

Decomp. by H_2O.

Antimony cæsium chloride, $SbCl_3$, $6CsCl$.

Decomp. by H_2O. Cryst. from dil. HCl+Aq. (Godeffroy, Arch. Pharm. (3), **12.** 47.)

$2SbCl_3$, $3CsCl$. Decomp. by H_2O; sl. sol. in cold, easily in hot dil. HCl+Aq. This is identical with the above salt. (Saunders, Am. Ch. J. **14.** 152.)

Antimony nitrosyl chloride, $SbCl_5$, $NOCl$.

Very deliquescent; decomp. by pure H_2O; sol. in H_2O containing tartaric acid. (Weber, Pogg. **123.** 347.)

$2SbCl_5$, $5NOCl$. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 661.)

Antimony phosphorus chloride, PCl_5, $SbCl_5$.

Deliquescent. (Weber, Pogg. **125.** 78.)

Antimony phosphoryl chloride, $SbCl_5$, $POCl_3$.

Deliquescent. (Weber.)

Antimony potassium chloride, $SbCl_3$, $2KCl$.

Sol. in H_2O without decomp. (Jacquelain, A. ch. (2) **66.** 128.)

Not deliquescent. Immediately decomp. by hot or cold H_2O. Sol. in HCl, or tartaric acid + Aq. (Benedikt, Proc. Am. Acad. **29.** 219.)

$+2H_2O$. Very efflorescent.

$SbCl_3$, $3KCl$. Deliquescent. Decomp. by hot H_2O. (Poggiale.)

$+2H_2O$. (Romanis, C. N. **49.** 273.)

Not obtained by Benedikt (*l.c.*).

See also **Antimony antimonyl potassium chloride.**

Antimony rubidium chloride, $SbCl_3$, $RbCl$.

Decomp. on air or with H_2O. (Saunders, Am. Ch. J. **14.** 162.)

$2SbCl_3$, $RbCl + H_2O$. Decomp. on air. (Wheeler, Z. anorg. **5.** 253.)

$SbCl_3$, $6RbCl$. Decomp. by H_2O. (Godeffroy, Arch. Pharm. (3) **9.** 343.)

Formula is $10SbCl_3$, $23RbCl$ (?). (Saunders, Am. Ch. J. **14.** 159.)

$10SbCl_3$, $23RbCl$ (?). Decomp. by H_2O; sol. in HCl + Aq. (Saunders.)

$3SbCl_3$, $5RbCl$. As above. (Saunders.)

Formula is $2SbCl_3$, $3RbCl$. (Wheeler.)

Antimony selenium chloride, $SbCl_5$, $SeCl_4$.

Deliquescent. (Weber.)

Antimony selenyl chloride, $SbCl_5$, $SeOCl_2$.

Very deliquescent. (Weber, Pogg. **125.** 325.)

Antimony sodium chloride, $SbCl_3$, $3NaCl$ (?).

Decomp. by much H_2O. (Poggiale.)

Antimony sulphur chloride, $2SbCl_5$, $3SCl_2$.

Decomp. by H_2O.

$SbCl_5$, SCl_4. Sol. in dil. HNO_3 + Aq.

Antimony *tri*chloride ammonia, $SbCl_3$, NH_3.

Not very deliquescent. Decomp. by H_2O.

Antimony *penta*chloride ammonia, $SbCl_5$, $6NH_3$.

Decomp. by H_2O. (Persoz.)

Antimony *penta*chloride cyanhydric acid, $SbCl_5$, $3HCN$.

Deliquescent; decomp. by H_2O. (Klein, A. **74.** 85.)

Antimony chloride potassium bromide, $K_6Sb_2Cl_6Br_6 + 3H_2O = K_3SbCl_3Br_3 + 1\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by much H_2O. (Atkinson, Chem. Soc. **43.** 289.)

See **Antimony bromide potassium chloride.**

$K_3Sb_2Cl_6Br_3 + 2H_2O$. (Atkinson.)

$KSbCl_3Br + H_2O$. (Atkinson.)

Antimony *penta*chloride nitric oxide, $2SbCl_5$, NO.

Decomp. by H_2O. (Besson, C.R. **108.** 1012.)

Antimony *penta*chloride nitrogen *per*oxide, $3SbCl_5$, $2NO_2$.

Decomp. by H_2O. (Besson.)

Antimony *tri*fluoride, SbF_3.

Deliquescent. Sol. in H_2O.

Antimony *penta*fluoride, SbF_5.

Sol. in H_2O. (Marignac, A. **145.** 239.)

Antimony lithium fluoride, SbF_3, $2LiF$.

Sol. in more than 20 pts. H_2O. (Flückinger, Pogg. **87.** 245.)

SbF_3, LiF. Easily sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony potassium fluoride, SbF_3, $2KF$.

Sol. in less than 2 pts. boiling, and in 9 pts. cold H_2O. Insol. in alcohol or ether.

SbF_3, KF. More sol. than SbF_3, $2KF$. Sol. in 2·8 pts. H_2O. (Flückinger, Pogg. **87.** 245.)

SbF_5, KF. Easily sol. in H_2O.

SbF_5, $2KF + 2H_2O$. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimony sodium fluoride, SbF_3, $3NaF$.

Sol. in 14 pts. cold, and 4 pts. boiling H_2O. Sol. in HF. (Flückinger, Pogg. **87.** 245.)

SbF_5, $2NaF$. Easily sol. in H_2O. (Marignac, A. **145.** 329.)

Antimony *tri*fluoride ammonium chloride. SbF_3, NH_4Cl.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride ammonium sulphate, SbF_3, $(NH_4)_2SO_4$.

More sol. than K or Na salt. 1 pt. H_2O dissolves 1·4 pts. salt at 24°. 1 pt. H_2O dissolves 15 pts. salt at 100°. (de Haen, B. **21.** 902 R.)

Antimony fluoride lithium chloride, SbF_3, $LiCl$.

Sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony *tri*fluoride potassium chloride, SbF_3, KCl.

100 pts. H_2O dissolve 51 pts. at 24°, and 300 pts. at 100°. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride potassium sulphate, SbF_3, K_2SO_4.

Sol. in H_2O. (de Haen.)

Antimony *tri*fluoride sodium chloride, SbF_3, $NaCl$.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride sodium sulphate, SbF_3, Na_2SO_4.

Sol. in H_2O. (de Haen.)

Antimony hydride, SbH_3.

Scarcely sol. in H_2O. 1000 ccm. H_2O absorb

4·12 ccm. SbH_3 at 10·5° Decomp. by long contact with H_2O; also by conc. H_2SO_4 or KOH+Aq. (Jones, Chem. Soc. **29.** 641.)

Antimony *tri*hydroxide, Sb_2O_3, $2H_2O=Sb_2O(OH)_4$.

(Schaffner, A. **51.** 182.)

$Sb(OH)_3$. Ppt. (Clarke and Stolla, B. **13.** 1787.)

Does not exist. (Guntz, C. R. **102.** 1472.)

See **Antimonous acid** *and* **antimony *tri*oxide.**

Antimony *tri*iodide, SbI_3.

Decomp. by H_2O or 80% alcohol. Sol. in HI+Aq; sol. in boiling CS_2, and in boiling benzene, but separates out on cooling. Almost insol. in $CHCl_3$. (Cooke, Proc. Am. Acad. (2) **5.** 72.)

Partly sol. in, and partly decomp. by alcohol or ether. (M'Ivor, Chem. Soc. (2) **14.** 328.)

Insol. in oil of turpentine and CCl_4.

100 pts. methylene iodide dissolve 11·3 pts. SbI_3 at 12°; sp. gr. of solution = 3·453. (Retgers, Z. anorg. **3.** 343.)

Antimony *penta*iodide, SbI_5.

Very unstable. (Pendleton, C.N. **48.** 97.)

Antimony barium iodide, SbI_3, BaI_2+9H_2O.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109.** 611.)

Antimony potassium iodide, 3KI, $2SbI_3+3H_2O$.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109.** 611.)

$2KI,SbI_3+2\frac{1}{2}H_2O$. Decomp. by H_2O. (Nicklès, J. Pharm. (3) **39.** 116.)

Antimony rubidium iodide, $2SbI_3$, 3RbI.

Decomp. by H_2O. (Wheeler, Z. anorg. **5.** 259.)

Antimony sodium iodide, $2SbI_3$, $3NaI+12H_2O$.

As $2SbI_3$, 3KI. (Schäffer, Pogg. **109.** 611.)

Antimony *tri*oxide, Sb_4O_6 (formerly Sb_2O_3).

Very sl. sol. in H_2O. Sol. in 8900-10,000 pts. H_2O at 100°; 55,000-61,100 pts. at 15°. (Schulze, J. pr. (2) **27.** 320.)

Sol. in HCl+Aq. Insol. in HNO_3+Aq, but not as insol. as metastannic acid. Sol. in cold fuming HNO_3 or H_2SO_4. Insol. in dil., but sol. in conc. alkalies, or alkali carbonates+Aq. Sol. in cold NH_4Cl, or NH_4NO_3+Aq. Sol. in 15 pts. boiling $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Sol. in $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq, and not pptd. from these solutions by H_2O. Easily sol. in benzoic acid. Insol. in pyrotartaric acid. Very sol. in $KHC_4H_4O_6$+Aq. Sol. in glycerine.

Min. *Valentinite, Senarmontite.*

Exists in a sol. colloidal modification. (Spring, B. **16.** 1142.)

$+H_2O$. *See* **Antimonous acid.**

Antimony *tetr*oxide, Sb_2O_4.

Insol. in H_2O. Slightly attacked by acids; hot conc. HCl+Aq acts only slightly. (Fresenius.)

Min. *Cervantite.* Sl. sol. in HCl+Aq.

Antimony *pent*oxide, Sb_2O_5.

Insol. in H_2O. Easily sol. in HCl+Aq. Sl. sol. in conc. KOH+Aq.

"Antimonoxyd" is sol. in glycerine in presence of alkalies.

100 g. glycerine, to which have been added:—10 g. NaOH+Aq (1:1), dissolve 20·6 g. at b.-pt.; 20 g. NaOH+Aq (1:1), dissolve 36·0 g. at b.-pt.; 40 g. NaOH+Aq (1:1), dissolve 68·5 g. at b.-pt.; 80 g. NaOH+Aq (1:1), dissolve 93·0 g. at b.-pt.; 120 g. NaOH+Aq (1:1), dissolve 119·2 g. at b.-pt. (Köhler, Dingl. **258.** 520.)

See also **Antimonic acid.**

Antimony oxybromide.

See **Antimonyl bromide.**

Antimony oxychloride.

See **Antimonyl chloride.**

Antimony oxyfluoride.

See **Antimonyl fluoride.**

Antimony oxysulphide, Sb_2OS_2.

Min. *Antimony blende* (*kermesite*).

Insol. in H_2O or dil. acids, except HCl+Aq. (Schneider, Pogg. **110.** 147.)

Antimony phosphide, SbP.

Insol. in benzene, ether, or CS_2. (M'Ivor, B. **6.** 1362.)

Antimony *tri*selenide, Sb_2Se_3.

Sol. in KOH+Aq. (Hofacker, A. **107.** 6.)

Antimony *penta*selenide, Sb_2Se_5.

(Hofacker.)

Antimony selenide, *with* **M selenide.**

See **Selenoantimonates, M.**

Antimony *tri*sulphide, Sb_2S_3 (*kermes*).

Insol. in H_2O and dil. acids. Decomp. by conc. HNO_3 or H_2SO_4. Sol. in conc. HCl+Aq. Easily sol. in dil. KOH, NaOH, $(NH_4)_2S$, and K_2S+Aq. Sl. sol. in NH_4OH+Aq; very sl. sol. in $(NH_4)_2CO_3$+Aq; insol. in KSH+Aq. (Fresenius.)

Slowly sol. in $H_2C_4H_4O_6$+Aq.

Sol. in boiling Na_3SbS_4+Aq.

Insol. in NH_4Cl+Aq.

Sol. in 14-15 pts. pure $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Sol. in ethylamine sulphydrate+Aq.

Min. *Stibnite.* Sol. in cold citric acid+Aq. (Bolton, C.N. **37.** 14.)

Soluble modification. Sb_2S_3 may be obtained in a colloidal state in aqueous solution containing 1 pt. Sb_2S_3 to 200 pts. H_2O. This can be boiled without decomp., but Sb_2S_3 is pptd. by acids and salts.

Table of maximum dilution of solutions of acids and salts which cause pptn. of Sb_2S_3.

HCl	1:270
H_2SO_4	1:140
$H_2C_2O_4$	1:45
K_2SO_4	1:65

Table of maximum dilution, etc.—*Continued.*

$(NH_4)_2SO_4$	1 : 130
$MgSO_4$	1 : 1720
$MnSO_4$	1 : 2060
NaCl	1 : 135
$BaCl_2$	1 : 2050
$MgCl_2$	1 : 5800
$CoCl_2$	1 : 2500
KNO_3	1 : 75
Fe_2Cl_6	1 : 2500
$Ba(NO_3)_2$	1 : 1250
$K_2Al_2(SO_4)_4$	1 : 35,000
$(NH_4)_2Fe_2(SO_4)_4$	1 : 800
$K_2Cr_2(SO_4)_4$	1 : 40,000
$KSbOC_4H_4O_6$	1 : 18

(Schulze, J. pr. (2) **27.** 320.)

Antimony *penta*sulphide, Sb_2S_5.

Insol. in H_2O, or H_2O containing H_2S. Sol. in conc. HCl+Aq. Completely sol. in NH_4OH+Aq; traces dissolve in $(NH_4)_2CO_3$+Aq. Easily sol. in KOH, or NaOH+Aq, or in alkali sulphides+Aq. Sol. in 50 pts. cold dil. NH_4OH+Aq. (Geiger.)

Insol. in $(NH_4)_2CO_3$+Aq.

Insol. in cold, but sol. in hot alkali carbonates+Aq. (Berzelius.)

Insol. in Na_3SbS_4+Aq.

When boiled with alcohol, ether, CS_2, oil of turpentine, etc., portion of the S is dissolved out. (Berzelius.)

CS_2 dissolves about 5 % of the sulphur. (Rammelsberg.)

Antimony sulphochloride, $SbSCl_3$.

Decomp. by moist air or H_2O. (Cloez, A. ch. (3) **30.** 374.)

SbS_2Cl. Easily attacked by acids; insol. in CS_2. (Ouvrard, C.R. **116.** 1516.)

Sb_2S_5Cl. (Ouvrard.)

2SbSCl, $3Sb_2S_3$. Decomp. by dil. HCl+Aq. (Schneider.)

SbSCl, $7SbCl_3$. Deliquescent; decomp. by H_2O. (Schneider, Pogg. **108.** 407.)

Antimony sulphoiodide, SbSI.

Not attacked by H_2O, and decomp. only by conc. acids. Insol. in CS_2. (Schneider, Pogg. **110.** 147.)

$Sb_2S_3I_6$. (Henry and Garot.)

$Sb_2S_2I_3$. Sol. in dry CS_2. Very easily decomp. (Ouvrard, C.R. **117.** 108.)

Antimony telluride, SbTe.

Insol. in H_2O.

Sb_2Te_3. Insol. in H_2O. (Oppenheim, J. pr. **71.** 277.)

Antimonyl bromide, SbOBr.

Insol. in CS_2. (Cooke, Proc. Am. Acad. **13.** 104.)

$Sb_4O_5Br_2$. (M'Ivor, C.N. **29.** 179.)

$10Sb_4O_5Br_2$, $SbBr_3$.

Antimonyl chloride.

From $SbCl_3$. SbOCl. Insol in H_2O. Decomp. by boiling with H_2O; sol. in HCl+Aq. Insol. in alcohol or ether; sol. in CS_2, $CHCl_3$, or C_6H_6. (Sabanajew, Zeit. Ch. **1871.** 204.)

$Sb_4O_5Cl_2$. *Algaroth powder.* Decomp. by H_2O. Sol. in HCl+Aq. (Cooke, Proc. Am. Acad. **13.** 1.)

$Sb_8O_{11}Cl_2$. (Cooke.)

Sb_8OCl_{22}.

$Sb_{41}O_{50}Cl_{23}$.

From $SbCl_5$. $SbOCl_3$. Deliquescent. Decomp. by H_2O. Sol. in H_2O. (Daubrawa, A. **184.** 118.)

Does not exist. (Anschütz and Evans, A. **239.** 285.)

Sb_3OCl_{13}. Deliquescent. Insol. in CS_2; easily sol. in tartaric acid+Aq. (Williams, C.N. **24.** 224.)

$Sb_3O_4Cl_7$. (Williams.)

SbO_2Cl. Decomp. by hot H_2O into $HSbO_3$.

Antimonyl fluoride.

From SbF_3 . $Sb_4O_3F_6$. Not deliquescent.

From SbF_5 . $3SbOF_3$, SbF_3.

Antimonyl sodium fluoride, $SbOF_3$, NaF+H_2O.

Deliquescent. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimonyl iodide, $Sb_4O_5I_2$.

Difficultly sol. in solution of tartaric acid or tartrates. Decomp. by HCl, HNO_3, or H_2SO_4+Aq. Easily sol. in alkalies, or $(NH_4)_2S$+Aq.

SbOI. Insol. in CS_2. (Cooke, Proc. Am. Acad. (2) **5.** 72.)

Antimonyl sulphide.

See **Antimony oxysulphide.**

Arsenic, As.

Unaltered by pure H_2O. Insol. in HCl+Aq if air is excluded, but sl. sol. in presence of air. Not attacked by dil. H_2SO_4+Aq. Oxidised by conc. H_2SO_4, HNO_3, or aqua regia. Not attacked at 20° by HNO_3, conc. or dil., or containing NO_2; nor by HNO_3+HCl, as long as they do not act on each other; but if treated with the above mixture in extremely dilute state, and a few drops of KNO_2+Aq are added, the As is attacked at once. (Millon, A. ch. (3) **6.** 101.)

Insol. in NaOH, KOH, or NH_4OH+Aq.

Sol. in S_2Br_2. (Hannay, Chem. Soc. (2) **11.** 823.)

Insol. in alcohol and ether.

Sol. in certain fatty oils.

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Arsenic acid. *See* page 31.

Arsenic bromide, $AsBr_3$.

Decomp. by H_2O. Completely sol. in about 3 pts. boiling H_2O, and much less, in presence of HBr. (Wallace, Phil. Mag. (4) **17.** 261.)

Sol. in CS_2.

Arsenic cæsium bromide, $2AsBr_3$, 3CsBr.

Decomp. by H_2O; can be recryst. from conc. HBr+Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium bromide, $2AsBr_3$, 3RbCl.

As the corresponding Cs comp.

Arsenic bromide ammonia, $AsBr_3$, $3NH_3$.

Decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic chloride, $AsCl_3$.

Miscible with little H_2O, and with alcohol, ether, and volatile oils. Decomp. by much H_2O, or by boiling. (Gmelin.)

Miscible with oil of turpentine, and with olive oil. Somewhat sol. in HCl + Aq.

Arsenic cæsium chloride, $2AsCl_3$, $3CsCl$.

Decomp. by H_2O. 100 pts. HCl + Aq (1·2 sp. gr.) dissolve 0·429 pt. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic iridium phosphorus chloride.

See **Iridium phosphorus chloride arsenic chloride.**

Arsenic rubidium chloride, $2AsCl_3$, $3RbCl$.

Decomp. by H_2O. 100 pts. HCl + Aq (sp. gr. 1·2) dissolve 2·935 pts. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic sulphur chloride, $2AsCl_3$, $3SCl_2$.

Decomp. by H_2O. (Rose.)

Above compound is a mixture. (Nilson, C. N. **81.** 81.)

Arsenic chloride ammonia, $2AsCl_3$, $7NH_3$.

Decomp. by cold H_2O, with evolution of NH_3. From the solution crystallises $As_4Cl_2N_2H_{10}O_8$.

Sol. in alcohol without decomp. (Rose, Pogg. **52.** 62.)

Composition is $AsCl_3$, $4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic *tri*fluoride, AsF_3.

Sol. in H_2O with evolution of heat and decomposition. (Berzelius.)

Easily sol. in benzene. (Moissan, C. R. **99.** 874.)

Miscible with alcohol and ether. (M'Ivor, C. N. **30.** 169.)

Arsenic potassium fluoride, AsF_5, $KF + \frac{1}{2}H_2O$.

AsF_5, $2KF + H_2O$.

AsF_5, $AsOF_3$, $4KF + 3H_2O$. (Marignac, A. **145.** 237.)

Arsenic fluoride ammonia, $2AsF_3$, $5NH_3$.

Easily decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic hydride, AsH_3.

Sl. sol. in H_2O and alkali hydrates + Aq, with subsequent decomposition. H_2O absorbs $\frac{1}{5}$ vol. AsH_3. Decomp. by conc. acids. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether, or KOH + Aq. (Gmelin.)

Insol. in KOH + alcohol. (Meissner.)

Not more sol. in alkaline solutions than in pure H_2O. (Berzelius.)

AsH. *Solid.* Insol. in H_2O, alcohol, ether, and CS_2. (Wiederhold, Pogg. **118.** 615.)

Insol. in H_2O; sol. in methylene iodide, xylene, or in conc. KOH + Aq. (Retgers, Z. anorg. **4.** 403.)

Arsenic *di*iodide, As_2I_4.

Decomp. by H_2O or alkalies; easily sol. in alcohol, ether, chloroform, or carbon disulphide. (Bamberger and Phillip, B. **14.** 2643.)

Arsenic *tri*iodide, AsI_3.

Sol. in 3·32 pts. boiling H_2O, and solution if boiled down deposits pure AsI_3, but if left to cool slowly, deposits crystals of As_2O_3 and AsOI.

Sl. sol. in HCl + Aq.

Sol. in alcohol without decomp.

Sol. in ether, benzene, chloroform, and CS_2.

100 pts. methylene iodide dissolve 17·4 pts. AsI_3 at 12°. (Retgers, Z. anorg. **3.** 343.)

Arsenic cæsium iodide, $2AsI_3$, $3CsI$.

Decomp. by H_2O; sol. in conc. HI + Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium iodide, $2AsI_3$, $3RbI$.

As the corresponding Cs comp.

Arsenic sulphur iodide.

See **Arsenic sulphoiodide.**

Arsenic *tri*iodide ammonia, $2AsI_3$, $9NH_3$.

Insol. in benzene. (Bamberger and Phillip, B. **14.** 2643.)

AsI_3, $4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic *sub*oxide, As_2O (?).

Insol. in H_2O; decomp by dil. acids or NH_4OH + Aq.

Does not exist. (Geuther, A. **240.** 208.)

Arsenic *tri*oxide, As_4O_6 (formerly As_2O_3).

"White arsenic" exists in two modifications: αAs_2O_3,—crystalline, octahedral, opaque, porcelaneous, etc.; βAs_2O_3,—amorphous, vitreous, "arsenic glass."

The data concerning the solubility of As_2O_3 are very contradictory, the reasons being that (1) the solubility of the two modifications is different; (2) that the length of time necessary to effect solution differs in the two modifications; and (3) that there is a tendency of the amorphous As_2O_3 to go over into the crystalline state during the process of solution. αAs_2O_3 is also not easily moistened, especially when in a pulverulent condition, which is not the case with the β modification. (Winkler, J. pr. (2) **31.** 247.)

The older data are very unreliable, but possess a certain historical interest.

1 pt. As_2O_3 is sol. in 10·55 pts. (Wenzel); 11·34 pts. (Fischer); 11·86 pts. in $\frac{1}{4}$ hour (Klaproth); 12·2 pts. (Bucholz); 15·0 pts. (Brandt; Bergman); 16·0 pts. (Vogel); 24 pts. (Lametherie); 40 pts. (Porner); 64 pts. (Baumé); 80 pts. (Navier); 200 pts. (Aschof and Nasse, 1812); 640 pts. (Hagen, 1796) boiling H_2O.

1 pt. As_2O_3 is sol. in 7·72 pts. H_2O if α, or 9·33 pts. if β (Guibort); in 24 pts. H_2O if α, or 21 pts. if β (Taylor).

Sol. in 53·3 pts. H_2O at 18·75°. (Abl.)

Sol. in 30 pts. H_2O. (Nussembrock.)

After the solution in H_2O at 100° has been left standing at ordinary temperatures—

1 pt. As_2O_3 remains dissolved in 16 pts. H_2O at 16°, and 20 pts. H_2O at 7° (Bucholz); in 33 pts. H_2O at 7° (Klaproth); in 38·45 pts. H_2O after 3 days, 55 pts. H_2O after 8 days, 64·50 pts. H_2O after 2-3 weeks at 10° (Fischer); in 33·52 pts. if αAs_2O_3 was used, 55·06 pts. if βAs_2O_3 was used (Guibort); in 38 pts. if αAs_2O_3 after 6 months, 53·71 pts. if βAs_2O_3 after 48 hours (Taylor).

When an excess of pulverised As_2O_3 is left to digest for several days with cold H_2O—

1 pt. dissolves in 50 pts. (Bucholz); in 66 pts. (Fischer); in 80 pts. at 15° (Bergman); in 80 pts. if α, and 103 pts. if β (Guibort); 96 pts. at 10° (Spelman); 96 pts. at 35·5° (Hahnemann); 320 pts. H_2O at 20° (Aschof and Nasse, 1812.)

H_2O at 15·6° or below dissolves less than $\frac{1}{4}$ % As_2O_3. (Dalton.)

To dissolve 1 pt. As_2O_3 in 12 pts. H_2O, it is necessary to boil an excess of As_2O_3 with H_2O; if 1 pt. As_2O_3 is boiled with 12 pts. H_2O, considerable remains undissolved; and even with 1 pt. As_2O_3 to 50-60 pts. H_2O long continued boiling is necessary to effect solution. If a clear solution saturated by long boiling with an excess of As_2O_3 is poured off and evaporated continuously to $\frac{1}{3}$ its original bulk, no As_2O_3 separates out, and the solution contains 1 pt. As_2O_3 to 6 pts. H_2O. (Fischer.)

100 pts. aqueous solution of βAs_2O_3 sat. at 15° contain 0·96 pt. As_2O_3, and 9·68 pts. when sat. at 100°. (Guibort.)

If 1 pt. pulverised As_2O_3 be digested 10 days at 19-25° in 5-10 pts. H_2O, the solution contains 1 pt. As_2O_3 to 50 pts. H_2O. A solution of same strength is obtained in 25 days by digesting 1 pt. As_2O_3 in 40 pts. H_2O. If 1 pt. As_2O_3 be immersed in 80 pts. H_2O, the resulting solution contains 1 pt. As_2O_3 to 90 pts. H_2O; if in 160 pts. H_2O, 1 pt. As_2O_3 to 180 pts. H_2O; if in 240 pts. H_2O, 1 pt. As_2O_3 to 280 pts. H_2O; if in 1000 pts. H_2O, 1 pt. As_2O_3 to 1200 pts. H_2O; and even when 1 pt. As_2O_3 is digested at ordinary temperatures for several days with 16,000-100,000 pts. H_2O, a portion remains undissolved. Pulverised αAs_2O_3 was set aside with H_2O in closed bottles for 18 years; when 1 pt. As_2O_3 was present in 1000 pts. H_2O, a perfect solution was obtained; when 1 pt. As_2O_3 in 100 pts. H_2O, 0·017 % As_2O_3 was undissolved; when 1 pt. As_2O_3 in 35 pts. H_2O, 0·35 % As_2O_3 was undissolved, so that the solution contained 1 pt. As_2O_3 to 54 pts. H_2O. (Gmelin.)

Porcelaneous modification (αAs_2O_3) is much more sol. in H_2O than the vitreous (βAs_2O_3). 100 pts. H_2O at ordinary temperature dissolve 0·96 pt. βAs_2O_3 and 1·25 pts. αAs_2O_3; 100 pts. boiling H_2O dissolve 9·68 pts. βAs_2O_3 and 11·47 pts. αAs_2O_3; and when the temperature of this solution has fallen to 15°, the solution from βAs_2O_3 retains 1·78 pts., and that from αAs_2O_3 retains 2·9 pts. (Berzelius [citing Guibort].)

βAs_2O_3 dissolves more quickly and abundantly than αAs_2O_3. The same amount H_2O which will take up 36-38 pts. βAs_2O_3 at 12-13° will dissolve only 12-14 pts. αAs_2O_3, or 100 pts. H_2O dissolve 4 pts. βAs_2O_3 and 1·2-1·3 pts. αAs_2O_3. By long boiling with H_2O, αAs_2O_3 is converted into βAs_2O_3, and thus acquires the solubility of the latter, so that 100 pts. boiling H_2O can take up 11 pts. As_2O_3. But at low temperature βAs_2O_3 is converted into αAs_2O_3 when in contact with H_2O, so that the solution becomes weaker after a while, and retains only the proportion of As_2O_3 corresponding to the solubility of αAs_2O_3. Comminution, which hastens the rate of solubility of αAs_2O_3 without increasing the amount dissolved, diminishes the solubility of βAs_2O_3, as this is converted into αAs_2O_3 by the friction or contact with H_2O. As_2O_3, which has been rendered opaque by NH_4OH, and that which has been crystallised from an aqueous solution, are equally sol. in H_2O. (Bussy, C.R. **24.** 774; A. **64.** 286.)

100 pts. H_2O dissolve 1·707 pts. βAs_2O_3 in 2½ years; 100 pts. boiling H_2O dissolve 11·46 pts. βAs_2O_3 in 3 hours, and 11·86 pts. in 12 hours; 10·14 pts. αAs_2O_3 in 3 hours, and 10·18 pts. in 12 hours. (Rose, Ann. Phys. (1) **36.** 494.)

A cold sat. solution which stood over excess of As_2O_3 for 10 months at 10-20° contains 1·2 % As_2O_3; hot sat. solution a few days after saturation contains 2·25-2·50 % As_2O_3. If trace of HCl is present, the solution contains 3·8 % As_2O_3. Hot sat. solution of porcelain mod. of As_2O_3 contains 4 days after saturation 2·4 % As_2O_3 at 24°; after 82 days at 14°, 1·5 %; after 4 months at 12°, 1·3 % As_2O_3. (Bacaloglo, J. pr. **83.** 111.)

According to later experiments, 1 pt. αAs_2O_3 dissolves in 355 pts. H_2O in 1 day at 15°, while 1 pt. βAs_2O_3 dissolves in 108 pts. H_2O under the same conditions. 1 pt. αAs_2O_3 dissolves in 46 pts. H_2O, if solution is prepared at 100°, and allowed to stand 24 hours at 15°, while 1 pt. βAs_2O_3 dissolves in 30 pts. H_2O under the same conditions. (Buchner, N. Rep. Pharm. **22.** 265.)

100 pts. H_2O dissolve pts. αAs_2O_3 and βAs_2O_3 at ordinary temperature:

Time.	αAs_2O_3	βAs_2O_3
1 hour	0·023	1·589
3 hours	0·088	2·356
6 hours	0·353	3·666
12 hours	0·364	3·361
24 hours	0·956	3·306
2 days	1·627	2·629
4 days	1·814	2·429
1 week	1·673	1·763
3 weeks	1·776	1·713
2½ years	1·712	1·707

In the solution of βAs_2O_3 octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of αAs_2O_3.

From the maxima in the above table, 100 pts. H_2O can dissolve 3·7 pts. βAs_2O_3 and 1·7 pts. αAs_2O_3 at ordinary temperature.

100 pts. boiling H_2O dissolve 11·46 pts. βAs_2O_3 and 10·140 pts. αAs_2O_3 in 3 hours; 11·86 pts. βAs_2O_3 and 10·176 pts. αAs_2O in 12 hours. (Cl. Winkler, J. pr. (2) **31.** 247.)

100 pts. H_2O dissolve 1·75 pts. of a third modification (hexagonal crystalline) at ordinary temperature, and 2·75 pts. at 100°. (Claudet, Chem. Soc. (2) **6.** 179.)

βAs_2O_3 dissolves more rapidly in HCl+Aq than αAs_2O_3. (Schultz-Sellac, B. **4.** 109.)

While 100 ccm. H_2O dissolve 0·8507 g. βAs_2O_3 at 18·5°, 100 ccm. H_2O containing 1·3195 g. HCl dissolve 1·1513 g. βAs_2O_3; containing 6·09 g. HCl, 1·2724 g. βAs_2O_3. (Chodounsky, Listy Chemické, **13.** 114.)

Much more easily sol. in many acids than in H_2O. Easily sol. in fuming H_2SO_4. (Schultz-Sellac.)

100 pts. dilute H_2SO_4+Aq of various strengths dissolve at t°:

t°	Pts. βAs_2O_3	t°	Pts. βAs_2O_3	Ratios of amts. dissolved at 80° : 18·5°
80	1·0195	18·5	0·5422	1·88 : 1
...	1·3664	...	0·7203	1·89 : 1
...	1·1933	...	0·6522	1·84 : 1

(Chodounsky, *l.c.*)

Decomp. by HNO_3 or aqua regia into As_2O_5.

Sol. in H_3PO_4+Aq. (Bergman.)

More sol. in HCl+Aq than in H_2SO_4, or HNO_3+Aq, and still less in $HC_2H_3O_2$+Aq.

Easily sol. in cold $H_2C_2O_4$+Aq. (Bergman.)

When pulverised, it dissolves in hot $H_2C_2O_4$+Aq, but separates out on cooling.

Easily sol. in hot benzoic acid +Aq.

Sol. in tartaric acid +Aq.

Easily sol. in alkali hydrates, or carbonates+Aq.

Easily sol. in NH_4 arsenite+Aq at 70-80°, crystallising out on cooling. (Berzelius.)

Sol. in hot $K_2C_2O_4$+Aq.

Sol. in $AsCl_3$. (Penney and Wallace.)

More sol. in $Na_2B_4O_7$+Aq than in H_2O.

Very sl. sol. in absolute alcohol. (Vogel.)

Sol. in 80 pts. highly rectified spirit. (Wenzel.)

When 1 pt. powdered As_2O_3 is digested 30 days in 10-40 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 60 pts. alcohol; when 1 pt. As_2O_3 is digested with 60-150 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 124-140 pts. alcohol. (Fischer.)

Sol. in 70-80 pts. alcohol. (Thompson.)

Alcohol dissolves 0·446 pt. βAs_2O_3. (Rose, A. Phys. (1) **52.** 455.)

100 pts. alcohol dissolve pts. As_2O_3:

Vol. % of alcohol	αAs_2O_3 at 15°	αAs_2O_3 at b.-pt. of alcohol	βAs_2O_3 at 15°
56	1·680	4·895	0·504
79	1·430	4·551	0·540
84	...	...	0·565
86	0·715	3·197	...
88	...	...	0·717
100	0·025	3·402	1·060

(Girardin, J. Pharm. (3) **46.** 269.)

100 pts. absolute alcohol dissolve 0·446 pt. βAs_2O_3 in $2\frac{1}{4}$ years. (Winkler, J. pr. (2) **31.** 347.)

Nearly insol. in ether.

100 pts. ether dissolve 0·454 pt. βAs_2O_3. (Winkler.)

Ether extracts 1 mg. As_2O_3 from sat. As_2O_3+Aq for every 15 ccm. ether used; less is extracted when the solution is acidified with HCl, and almost none if acidified with H_2SO_4 or $H_2C_4H_4O_6$. (Selmi, B. **13.** 206.)

βAs_2O_3 dissolves in oil of turpentine, but αAs_2O_3 is insol. therein. αAs_2O_3 is very sl. sol. in benzene or petroleum ether, but more sol. in methyl alcohol, ethyl alcohol, ether, or chloroform. (Selmi.)

100 pts. CS_2 dissolve 0·001 pt. βAs_2O_3 in $2\frac{1}{4}$ years. (Winkler.)

Sl. sol. in the fatty oils.

1000 pts. castor-oil dissolve 1·33 pts. As_2O_3 at ordinary temperature, and 9 pts. at boiling temperature. 1000 pts. other oils dissolve 0·6-0·8 pt. As_2O_3 in the cold, and about 1·7 pts. on boiling. (Berzelius.)

Insol. in quinoline or aniline. (Hoffmann, A. ch. (3) **9.** 143, 169.)

Min. *Arsenolite.*

Arsenic *tri*oxide *pent*oxide.

$3As_2O_3, 2As_2O_5+3H_2O$. Decomp. by H_2O. (Joly, C. R. **100.** 1221.)

$2As_2O_3, As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

$As_2O_3, As_2O_5+H_2O$. (Joly.)

Arsenic *pent*oxide, As_2O_5.

Deliquescent in moist air; slowly sol. in H_2O, forming H_3AsO_4, which see. Easily sol. in alcohol; much more sol. in alcohol than As_4O_6. Very sl. sol. in the fatty oils, 1000 pts. of oil dissolving 0·2 pt. As_2O_5 in the cold, and 1 pt. with partial decomp. on boiling. (Berzelius.)

1000 pts. boiling poppy-oil dissolve 27 pts. As_2O_5; 1000 pts. boiling castor-oil dissolve 34 pts. As_2O_5. (Heimpel and Grundner.)

Arsenic *tri*oxide, *with* alkali haloid.

See **Arsenite, alkali haloid.**

Arsenic sulphur *tri*oxide.

As_2O_3, SO_3. Deliquescent; decomp. by H_2O. (Adie, Chem. Soc. **55.** 157.)

$As_2O_3, 2SO_3$. As above. (Adie.)

$As_2O_3, 3SO_3$. (Weber.)

$As_2O_3, 4SO_3$. As above. (Adie.)

$As_2O_3, 6SO_3$. (Weber, B. **19.** 3186.)

$As_2O_3, 8SO_3$. As above. (Adie.)

Arsenic oxychloride, etc.

See **Arsenyl chloride,** etc.

Arsenic phosphide, AsP.

Decomp. by H_2O. Not attacked by cold H_2SO_4 or HCl, and only sl. sol. therein on warming. Easily decomp. by HNO_3, KOH, NaOH, BaO_2H_2+Aq. Insol. in alcohol, ether, chloroform; sl. sol. in CS_2.

$P_2As_3O_3$. Product of action of H_2O on above compound, which it resembles. (Janowsky, B. **6.** 216.)

Arsenic *tri*selenide, As_2S_3.

Partially sol. in KOH+Aq if boiled with it for a long time. (Uelsmann, A. **116.** 123.)

Arsenic selenosulphide.

See **Arsenic sulphoselenide.**

Arsenic *di*sulphide, As_2S_2.

Min. *Realgar.* Difficultly sol. in alkali sulphides+Aq. Partly dissolved by KOH+Aq with decomposition. Sol. at 150° in a sealed tube in $NaHCO_3$+Aq, and crystallises out on cooling. (Senarmont, A. ch. (3) **32.** 158.)

Arsenic *tri*sulphide, As_2S_3.

Insol. in H_2O when prepared in the dry way, but when prepared moist is very liable to go into the colloidal modification mentioned below. Insol. in H_2O containing H_2SO_4, HNO_3, HCl, $H_2C_2O_4$, $HC_2H_3O_2$, $H_2C_4H_4O_6$, CO_2, NH_4Cl, KNO_3, $(NH_4)_2SO_4$, $MgSO_4$. (Bontigny.)

Insol. in H_2O. Traces are dissolved by H_2S+Aq. Sl. decomp. by boiling with H_2O, or long contact with cold H_2O. (Fresenius.)

Insol. in dil. acids. Insol. in cold, and scarcely attacked by hot conc. HCl+Aq.

Easily decomp. by HNO_3 or aqua regia.

Easily sol. in cold KOH, NaOH, or NH_4OH +Aq, also in alkali carbonates, or sulphates+Aq.

Sol. in hot $KHSO_3$+Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Insol in CS_2.

Min. *Orpiment.*

As_2S_3 may also be obtained in a colloidal form, sol. in H_2O. Sat. solution contains 34·46 % As_2S_3; it is decomp. by standing, but may be boiled without undergoing decomposition; most acids and many salts ppt. As_2S_3. (Schulze, J. pr. (2) **25.** 431.)

The following solutions cause pptn. of As_2S_3 in a solution of the colloidal modification, when added in the given state of dilution:—

$HCl+Aq$	1 : 555
HNO_3+Aq	1 : 276
H_2SO_4+Aq	1 : 255
H_2SO_3+Aq	1 : 138
$H_2C_2O_4+Aq$	1 : 65
H_3PO_4+Aq	1 : 26
$HC_2H_3O_2+Aq$	1 : 0·18
K_2SO_4+Aq	1 : 76
Na_2SO_4+Aq	1 : 129
$(NH_4)_2SO_4+Aq$	1 : 188
$CaSO_4+Aq$	1 : 2780
$MgSO_4+Aq$	1 : 2630
$ZnSO_4+Aq$	1 : 3330
$MnSO_4+Aq$	1 : 2860
$NiSO_4+Aq$	1 : 3440
$FeSO_4+Aq$	1 : 2380
$Al_2(SO_4)_3+Aq$	1 : 52600
Tl_2SO_4+Aq	1 : 799
$KCl+Aq$	1 : 137
$KBr+Aq$	1 : 103
$KI+Aq$	1 : 55
$LiI+Aq$	1 : 127
$NaCl+Aq$	1 : 212
NH_4Cl+Aq	1 : 207
$BaCl_2+Aq$	1 : 2860
$CaCl_2+Aq$	1 : 4370
$MgCl_2+Aq$	1 : 10000
$FeCl_3+Aq$	1 : 50000
$AlCl_3+Aq$	1 : 83000
$CrCl_3+Aq$	1 : 20000
KNO_3+Aq	1 : 84
$NaNO_3+Aq$	1 : 117
NH_4NO_3+Aq	1 : 138
$Ba(NO_3)_2+Aq$	1 : 2080
$KClO_3+Aq$	1 : 88
$CaH_2(CO_3)_2+Aq$	1 : 3120
$K_2C_2H_4O_6+Aq$	1 : 85
$K_2C_2O_4+Aq$	1 : 81
$NaC_2H_3O_2+Aq$	1 : 78
Urea $+Aq$	1 : 25
$(NH_4)_2Fe(SO_4)_2+Aq$	1 : 1160
$K_2Al_2(SO_4)_4+Aq$	1 : 50000
$K_2Fe_2(SO_4)_4+Aq$	1 : 55500
$K_2Cr_2(SO_4)_4+Aq$	1 : 25000
$K_4Fe(CN)_6+Aq$	1 : 67
$K_3Fe(CN)_6+Aq$	1 : 81

Cold conc. solutions of boric, arsenious, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn. (Schulze, J. pr. (2) **25.** 442.)

Arsenic *penta*sulphide, As_2S_5.

Insol. in H_2O. Sol. in NH_4OH, KOH, $NaOH+Aq$, and solutions of alkali sulphides and carbonates. Sol. in BaO_2H_2, and CaO_2H_2+Aq.

Sol. in citric acid, and alkali citrates + Aq. (Spiller.)

Alcohol dissolves out S on boiling. (Berzelius.)

Sol. in alkali arsenates + Aq. (Nilson, J. pr. (2) **14.** 155.)

$+H_2O$. (Nilson, *l.c.*)

Arsenic *tri*sulphide, *with* M_2S.

See **Sulpharsenite, M.**

Arsenic *penta*sulphide, *with* M_2S.

See **Sulpharsenate, M.**

Arsenic sulphobromide, $AsS_2Br_3=AsSBr+SBr_2$.

Decomp. by H_2O. (Hannay, Chem. Soc. **33.** 284.)

Arsenic sulphochloride, As_2S_5Cl.

Slowly decomp. by boiling H_2O. Sol. in hot $AsCl_3$ without decomp. (Ouvrard, C. R. **116.** 1516.)

AsS_2Cl. Decomp. by H_2O. Sol. in NH_4OH, and alkali carbonates + Aq. (Ouvrard.)

Arsenic sulphoiodide, AsSI.

Insol. in alcohol, chloroform, or carbon disulphide. (Schneider, J. pr. (2) **23.** 486.)

Formula is probably As_2S_3, AsI_3.

Slowly attacked by $HCl+Aq$; somewhat more easily by HNO_3+Aq. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **34.** 505.)

$2AsI_3$, SI_6. Decomp. on air. (Schneider, J. pr. (2) **36.** 509.)

$As_4S_5I_2$. Less sol. in CS_2 than AsI_3. (Ouvrard, C. R. **117.** 107.)

As_2SI_4. (Ouvrard.)

See also **Arsenyl sulphoiodide.**

Arsenic sulphoselenide, As_2SeS_2.

Easily sol. in cold NH_4SH+Aq. Nearly completely sol. in $(NH_4)_2CO_3+Aq$. (v. Gerichten, B. **7.** 29.)

As_2SSe_2. More difficultly sol. than the preceding comp. in NH_4SH+Aq. (v. Gerichten.)

Arsenic telluride, As_2Te_2 (?).

(Oppenheim, J. pr. **71.** 266.)

As_2Te_3 (?). (Oppenheim.)

Arsenic acid, anhydrous, As_2O_5.

See **Arsenic *pent*oxide.**

***Meta*arsenic acid,** $HAsO_3$.

Slowly sol. in cold, quite easily sol. in hot H_2O, with considerable evolution of heat, and conversion into H_3AsO_4. (Kopp, A. ch. (3) **48.** 196.)

***Ortho*arsenic acid,** H_3AsO_4.

Sol. in H_2O, with absorption of heat.

1 pt. As_2O_5 dissolves in 0·405 pt. H_2O at 12·5°, or 100 pts. H_2O dissolve 244·81 pts. As_2O_5 at 12·5°. (Vogel.)

Sol. in 0·5 pt. H_2O. (Thénard.)

Sol. in 6 pts. cold H_2O, and more quickly in 2 pts. hot H_2O. (Bucholz.)

100 pts. H_2O at 15·56° dissolve 150 p As_2O_5. (Ure's Dict.)

H_3AsO_4+Aq sat. at 15° contains 15 % A

Sp. gr. of H_3AsO_4+Aq at 15° : *a*=sp. gr. if % is As_2O_5 ; *b*=sp. gr. if % is H_3AsO_4.

%	*a*	*b*	%	*a*	*b*
5	1·042	1·0337	45	1·540	1·3973
10	1·085	1·0690	50	1·635	1·4617
15	1·134	1·1061	55	1·742	1·5320
20	1·187	1·1457	60	...	1·6086
25	1·245	1·1882	65	...	1·6919
30	1·306	1·2342	70	...	1·7827
35	1·378	1·2840	75	...	...
40	1·453	1·3382	...	...	...

(Schiff, A. **113.** 183, calculated by Gerlach, Z. anal. **27.** 303.)

Sp. gr. of H_3AsO_4+Aq at 15° : *a*=sp. gr. if % is As_2O_5 ; *b*=sp. gr. if % is H_3AsO_4.

%	*a*	*b*	%	*a*	*b*
1	1·008	1·006	47	1·564	1·412
2	1·016	1·013	48	1·582	1·425
3	1·023	1·019	49	1·601	1·437
4	1·031	1·026	50	1·620	1·450
5	1·039	1·032	51	1·642	1·464
6	1·048	1·039	52	1·663	1·478
7	1·057	1·046	53	1·685	1·491
8	1·065	1·052	54	1·706	1·505
9	1·074	1·059	55	1·728	1·519
10	1·083	1·066	56	1·752	1·534
11	1·092	1·073	57	1·777	1·549
12	1·102	1·081	58	1·801	1·564
13	1·111	1·088	59	1·825	1·579
14	1·121	1·096	60	1·850	1·594
15	1·130	1·103	61	1·880	1·610
16	1·140	1·111	62	1·910	1·626
17	1·150	1·119	63	1·940	1·643
18	1·160	1·126	64	1·970	1·659
19	1·170	1·134	65	2·000	1·675
20	1·180	1·142	66	2·030	1·693
21	1·191	1·150	67	2·060	1·712
22	1·203	1·158	68	2·090	1·730
23	1·214	1·167	69	2·120	1·749
24	1·226	1·175	70	2·150	1·767
25	1·237	1·183	71	...	1·788
26	1·249	1·192	72	...	1·809
27	1·261	1·201	73	...	1·830
28	1·274	1·210	74	...	1·851
29	1·286	1·219	75	...	1·872
30	1·298	1·228	76	...	1·897
31	1·312	1·238	77	...	1·921
32	1·325	1·248	78	...	1·946
33	1·339	1·257	79	...	1·970
34	1·352	1·267	80	...	1·995
35	1·366	1·277	81	...	2·020
36	1·381	1·288	82	...	2·045
37	1·396	1·299	83	...	2·070
38	1·411	1·309	84	...	2·095
39	1·426	1·320	85	...	2·120
40	1·441	1·331	86	...	2·149
41	1·458	1·342	87	...	2·178
42	1·475	1·353	88	...	2·207
43	1·492	1·366	89	...	2·236
44	1·509	1·376	90	...	2·265
45	1·526	1·387	91	...	2·295
46	1·545	1·400	...	...	...

(Kopp, calculated by Gerlach, Z. anal. **27.** 316.)

***Pyro*arsenic acid,** $H_4As_2O_7$.

Very deliquescent ; easily sol. in H_2O with evolution of much heat, and conversion into H_3AsO_4.

Arsenates.

Arsenates of the alkali metals, and acid arsenates of the alkaline-earth metals are sol. in H_2O. Neutral and basic arsenates are easily sol. in mineral acids, including H_3AsO_4 ; less sol. in $HC_2H_3O_2$+Aq. The neutral alkaline-earth arsenates are less sol. in NH_4OH+Aq than in H_2O, but more sol. in NH_4Cl+Aq (Field). The alkali arsenates are sol. in hot glycerine. (Lefèvre, C. R. **108.** 1058.)

Aluminum arsenate, $Al_2(AsO_4)_2$.

Ppt. Insol. in H_2O ; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

$2Al_2O_3$, $3As_2O_5$. Nearly unattacked by boiling H_2O ; sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Aluminum potassium arsenate, $2Al_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Aluminum sodium arsenate, $2Al_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Ammonium arsenate, $(NH_4)_3AsO_4+3H_2O$.

Difficultly sol. in H_2O. Less sol. in H_2O than $(NH_4)_2HAsO_4$. (Mitscherlich.)

Ammonium hydrogen arsenate, $(NH_4)_2HAsO_4$.

Effloresces, giving off NH_3 ; more sol. in H_2O than $(NH_4)_3AsO_4$. (Salkowsky, J. pr. **104.** 129.)

Ammonium *di*hydrogen arsenate, $NH_4H_2AsO_4$.

Not efflorescent. Very sol. in H_2O.

Ammonium barium arsenate, $NH_4BaAsO_4+\frac{1}{2}H_2O$.

Ppt.

$(NH_4)_2BaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O ; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

Ammonium calcium arsenate, $NH_4CaAsO_4+6H_2O$.

Sol. in hot, very sl. sol. in cold H_2O ; sl. sol. in NH_4Cl, and NH_4OH+Aq. (Wach, Schw. J. **12.** 285.)

$+\frac{1}{2}H_2O$.

1000 pts. pure H_2O dissolve 0·20 pt. this salt ; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 4·15 pts. this salt ; 900 pts. H_2O+100 pts. NH_4OH (sp. gr.=0·880) dissolve 0·01 pt. this salt. (Field, Chem. Soc. **11.** 6.)

$+7H_2O$. (Bloxam, C. N. **54.** 163.)

$(NH_4)_2CaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O ; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

$Ca_2(NH_4)H_2(AsO_4)_3+3H_2O$.

$Ca_6(NH_4)H_5(AsO_4)_6+3H_2O$. (Bloxam, C. N. **54.** 163.)

Ammonium magnesium arsenate, NH_4MgAsO_4.

Sl. sol. in H_2O. Sol. in acids.

Anhydrous salt is sol. in 2784 pts. H_2O at 15°; in 15,904 pts. NH_4OH+Aq (1 : 3) (0·96 sp. gr.); in 1386 pts. NH_4Cl+Aq (1 : 70); in 886·7 pts. NH_4Cl+Aq (1 : 7); in 3014 pts. NH_4Cl (1 pt.)+NH_4OH (0·96 sp. gr.) (10 pts.)+Aq (60 pts.); in 32,827 pts. magnesia mixture. (Fresenius, Z. anal. **3.** 206.)

Anhydrous salt is sol. in 4389 pts. NH_4NO_3+Aq (1 : 50); in 2561·5 pts. KCl+Aq (1 : 165); in 1422 pts. ammoniacal solution of 3·5 g. tartaric acid in 250 ccm. H_2O; in 933·5 pts. ammoniacal solution of 2·5 g. citric acid in 250 ccm. H_2O. (Puller, Z. anal. **10.** 62.)

$+\frac{1}{2}H_2O$.

Sol. in 2656 pts. H_2O at 15°; in 15,038 pts. NH_4OH+Aq (1 : 3) (0·96 sp. gr.); in 844 pts. NH_4Cl+Aq (1 : 7); in 1315 pts. NH_4Cl+Aq (1 : 70); in 2871 pts. NH_4Cl (1 pt.)+NH_4OH (0·96 sp. gr.) (10 pts.)+Aq (60 pts.). (Fresenius.)

1000 pts. pure H_2O dissolve 0·14 pt. salt; 1000 pts. NH_4Cl+Aq (containing 100 pts. NH_4Cl) dissolve 0·95 pt. salt; 900 pts. H_2O +100 pts. NH_4OH (sp. gr. 0·880) dissolve 0·07 pt. salt. (Field, Chem. Soc. **11.** 6.)

$+6H_2O$. Sl. efflorescent. Sl. sol. in H_2O. Very sl. sol. in NH_4OH+Aq.

Ammonium manganous arsenate, $NH_4MnAsO_4+6H_2O$.

Nearly insol. in cold H_2O; easily sol. in dil. acids; insol. in alcohol.

Ammonium sodium arsenate, $NH_4NaHAsO_4+4H_2O$.

Sol. in H_2O. (Uelsmann, Zeit. f. ges. Nat. **23.** 347.)

Ammonium sodium hydrogen arsenate, $H_6(NH_4)_3Na_3(AsO_4)_4+6H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **94.** 649.)

Ammonium strontium arsenate, $NH_4SrAsO_4+\frac{1}{2}H_2O$.

Ppt.

Ammonium uranyl arsenate, $NH_4(UO_2)AsO_4+xH_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions as NH_4Cl+Aq; sol. in mineral acids. (Puller, Z. anal. **10.** 72.)

Ammonium vanadium arsenate, $NH_4(VO_2)_2AsO_4$, and $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$.

See **Arseniovanadate, ammonium.**

Antimony arsenate (?).

Insol. in H_2O; insol. in acids after ignition, but when fresh is sol. in conc. boiling HCl+Aq, and sl. sol. in HNO_3+Aq. (Dumas.)

Barium arsenate, $Ba_3(AsO_4)_2$.

1000 pts. pure H_2O dissolve 0·55 pt. $Ba_3(AsO_4)_2$; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 1·95 pts. $Ba_3(AsO_4)_2$; 900 pts. H_2O+100 pts. NH_4OH+Aq (sp. gr. =0·88) dissolve 0·03 pt. $Ba_3(AsO_4)_2$. (Field, Chem. Soc. **11.** 6.)

Sol. in cold HNO_3, and HCl+Aq (Berzelius); $H_2C_4H_4O_6$, and $HC_2H_3O_2$+Aq. (Anthon.)

Solubility in H_2O is not increased by presence of NH_4, Na, or K salts. (Laugier.)

Not pptd. in presence of Na citrate. (Spiller.)

$+1\frac{1}{2}H_2O$. (Salkowsky, J. pr. **104.** 129.)

Barium hydrogen arsenate, $BaHAsO_4+1\frac{1}{2}H_2O$.

Very sl. sol. in H_2O, but decomp. thereby into $Ba_3(AsO_4)_2$ and $BaH_4(AsO_4)_2$. (Berzelius.)

Sl. sol. in cold acids.

$+H_2O$. Sl. sol. in either $BaCl_2$+Aq or Na_2HAsO_4+Aq. (Maumené, J. B. **1864.** 237.)

Barium *tetra*hydrogen arsenate, $BaH_4(AsO_4)_2$.

Easily sol. in H_2O. (Setterberg, Berz. J. B. **26.** 206.)

Barium arsenate, acid, BaO, $2As_2O_5+4H_2O$.

Very sl. sol. in H_2O. (Mitscherlich.)

Barium *pyro*arsenate, $Ba_2As_2O_7$.

Insol. in H_2O, but decomp. thereby into $BaHAsO_4+H_2O$. (Lefèvre, C. R. **108.** 1058.)

Barium potassium arsenate, $BaKAsO_4$.

Sl. decomp. by cold H_2O; rapidly sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 1.)

Barium arsenate chloride, $3Ba_3(AsO_4)_2$, $BaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Bismuth arsenate, basic, $BiAsO_4$, $3Bi_2O_3$.

Insol. in H_2O. Sol. in mineral acids. (Cavazzi, Gazz. ch. it. **14.** 289.)

$5Bi_2O_3$, $2As_2O_5+8H_2O$. Min. *Rhagite.*

Easily sol. in HCl+Aq; sl. sol. in HNO_3+Aq.

Bismuth arsenate, $BiAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. Insol. in HNO_3+Aq in presence of H_3AsO_4, or alkali arsenates+Aq; sol. in HCl+Aq. (Salkowsky, J. pr. **104.** 129.)

Not wholly insol. in HNO_3+Aq. (Schneider, J. pr. (2) **20.** 418.)

Very sol. in H_3AsO_4+Aq. (Dumas.)

Insol. in $Bi(NO_3)_3$+Aq. (Dumas.)

Sol. in $Bi(NO_3)_3$+Aq. (Salkowsky.)

Insol. in conc. $Bi(NO_3)_3$+Aq containing a small quantity of HNO_3. (Schneider.)

Bismuth copper arsenate, $Bi_2Cu_{20}As_{10}H_{44}O_{70}=Bi_2O_3$, 20CuO, $5As_2O_5+22H_2O$.

Min. *Mixite.* Decomp. by dil. HNO_3+Aq into insol. $BiAsO_4$, and $Cu_3(AsO_4)_2$, which goes into solution. (Dana.)

Bismuth uranyl arsenate, $Bi_2(AsO_4)_2$, $8BiO_3H_3$, $(UO_2)_3(AsO_4)_2$.

Min. *Walpurgite.*

Cadmium arsenate, $Cd_3(AsO_4)_2$.

Ppt. (Salkowsky, J. pr. **104.** 129.)

2CdO, As_2O_5. (Lefèvre, C. R. **110.** 405.)

5CdO, $2As_2O_5+5H_2O$. Ppt. (Salkowsky.)

Cadmium *pyro*arsenate, $Cd_2As_2O_7$.

(de Schulten.)

Cadmium hydrogen arsenate, $CdHAsO_4+H_2O$.

Decomp. by H_2O. (Demel, B. **12.** 1279.)

$CdH_4(AsO_4)_2+2H_2O$. Decomp. by excess of H_2O. (de Schulten, Bull. Soc. (3) **1.** 473.)

Cadmium potassium arsenate, $2CdO$, K_2O, As_2O_5.

(Lefèvre, C. R. **110.** 405.)

Cadmium sodium arsenate, CdO, $2Na_2O$, As_2O_5.

Slowly sol. in dil. acids. (Lefèvre, C. R. **110.** 405.)

$2CdO$, $4Na_2O$, $3As_2O_5$. (Lefèvre.)

Cadmium arsenate bromide, $3Cd_3(AsO_4)_2$, $CdBr_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten, Bull. Soc. (3) **1.** 472.)

Cadmium arsenate chloride, $3Cd_3(AsO_4)_2$, $CdCl_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten.)

Calcium arsenate, $Ca_3(AsO_4)_2+3H_2O$.

Ppt. Insol. in H_2O; sol. in H_3AsO_4+Aq. (Kotschoubey, J. pr. **49.** 182.)

Calcium ***pyro*****arsenate,** $Ca_2As_2O_7$.

Slowly decomp. by cold H_2O into $CaHAsO_4+1\frac{1}{3}H_2O$. (Lefèvre.)

Calcium hydrogen arsenate, $CaHAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. (Debray, A. ch. (3) **61.** 419.)

$+H_2O$. Min. *Haidingerite.* Easily sol. in acids.

$+2\frac{1}{2}H_2O$. Min. *Pharmacolite.* Easily sol. in acids.

$+3H_2O$. Insol. in H_2O; sol. in HCl, HNO_3, or H_3AsO_4+Aq; also in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Pfaff.)

Calcium ***tetra*****hydrogen arsenate,** $CaH_4(AsO_4)_2$.

Sol. in H_2O. (Graham.)

Calcium ferric arsenate, $6CaO$, $4Fe_2O_3$, $5As_2O_5+15H_2O$ (?).

Min. *Arseniosiderite.* Sol. in acids.

Calcium magnesium arsenate, $Ca_5H_2(AsO_4)_4$, $Mg_5H_2(AsO_4)_4+10H_2O$.

Min. *Picropharmacolite.* Easily sol. in acids.

$Ca_3(AsO_4)_2$, $Mg_3(AsO_4)_2$. Sol. in HNO_3+Aq. (Kühn.)

Min. *Berzeliite.* Sol. in HNO_3+Aq.

$Ca_8Mg_6H_{14}(AsO_4)_{14}+49H_2O$. Min. *Wapplerite.*

Calcium potassium arsenate, $CaKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Calcium sodium arsenate, $CaNaAsO_4$.

(Lefèvre, A. ch. (6) **27.** 1.)

$4CaO$, $2Na_2O$, $3As_2O_5$. Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Calcium uranyl arsenate, $Ca(UO_2)_2(AsO_4)_2+8H_2O$.

Min. *Uranospinite.*

Calcium vanadium arsenate, $CaHAsO_4$, $2(VO_2)H_2AsO_4+8H_2O$.

See **Arseniovanadate, calcium.**

Calcium arsenate chloride, $Ca_3(AsO_4)_2$, $CaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

$3Ca_3(AsO_4)_2$, $CaCl_2$. As above. (Lechartier.)

Cerous arsenate, $CeHAsO_4$.

Insol. in H_2O. Sol. in arsenic acid$+Aq$. (Berzelius.)

Chromic arsenate, $2Cr_2O_3$, $3As_2O_5$.

Insol. in H_2O and conc. boiling acids. (Lefèvre, A. ch. (6) **27.** 5.)

Chromic potassium arsenate, $2Cr_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Chromic sodium arsenate, $2Cr_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Cobaltous arsenate, basic, $4CoO$, As_2O_5.

Easily sol. in acids. (Gentele, J. B. **1851.** 359.)

$Co(CoOH)AsO_4$. Insol. in H_2O; difficultly sol. in acids. (Coloriano.)

Cobaltous arsenate, $Co_3(AsO_4)_2+8H_2O$.

Ppt. Insol. even in boiling H_2O; easily sol. in HNO_3, HCl, and NH_4OH+Aq; sol. in H_3AsO_4+Aq (Proust); sol. in dil. $FeSO_4+Aq$. (Karsten, Pogg. **60.** 266.)

Min. *Cobalt bloom*, *Erythrite.* Easily sol. in acids.

$5CoO$, $2As_2O_5+3H_2O$. Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

$2CoO$, As_2O_5. Sl. attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Cobaltous hydrogen arsenate, $CoH_4(AsO_4)_2$.

Sol. in H_2O.

Cobaltous potassium arsenate, $CoKAsO_4$.

(Lefèvre.)

Cobaltous sodium arsenate, $CoNaAsO_4$.

(Lefèvre.)

$4CoO$, $2Na_2O$, $3As_2O_5$. (Lefèvre.)

Cobaltous vanadium arsenate, $Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

See **Arseniovanadate, cobaltous.**

Cupric arsenate, basic, $8CuO$, $As_2O_5+12H_2O$ (?).

Min. *Chalcophyllite.* Easily sol. in acids and NH_4OH+Aq.

$6CuO$, $As_2O_5+3H_2O$. Min. *Aphanesite*, *Chioclasite.* Sol. in acids and ammonia.

$5CuO$, $As_2O_5+2H_2O$. Min. *Erinite.* Sol. in HNO_3+Aq.

$+5H_2O$. Min. *Cornwallite.* Sol. in acids, and NH_4OH+Aq.

$4CuO$, $As_2O_5+H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61.** 423.)

Min. *Olivenite.* Sol. in acids, and NH_4OH+Aq; decomp. by hot $KOH+Aq$.

$+7H_2O$. Min. *Euchroite.* Sol. in HNO_3+Aq.

$+3\frac{1}{2}H_2O$. (Hirsch, C. C. **1891, 1.** 15.)

Cupric arsenate, $Cu_3(AsO_4)_2+4H_2O$.

Insol. in H_2O.

Sol. in acids, and NH_4OH+Aq. (Coloriano, C. R. **103.** 273.)

$+5H_2O$.

Min. *Trichalcite*. Easily sol. in cold $HCl+Aq$.

Cupric arsenate, acid, $5CuO, 2As_2O_5$.

Sol. in H_2SO_3+Aq. (Vogel.)

$+3H_2O$. (Salkowsky.)

$CuHAsO_4$. Insol. in H_2O. (Coloriano.)

$+1\frac{1}{2}H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61**. 419.)

$8CuO, 3As_2O_5$. (Hirsch.)

Cupric lead arsenate, $3CuO, PbO, As_2O_5+2H_2O$.

Min. *Bayldonite*. Nearly insol. in HNO_3+Aq.

Cupric potassium arsenate, $CuKAsO_4$.

Slowly sol. in NH_4OH+Aq; easily sol. in acids. (Lefèvre, A. ch. (6) **27**. 5.)

$8CuO, K_2O, As_2O_5$. Easily sol. in dil. acids. (Lefèvre.)

Cupric sodium arsenate, $CuNaAsO_4$.

(Lefèvre.)

$3CuO, Na_2O, 2As_2O_5$. Very sol. in dil. acids. (Lefèvre.)

$2Cu_3(AsO_4)_2, NaH_2AsO_4 + 5H_2O$. Ppt. (Hirsch, C. C. **1891, 1**. 15.)

$6Cu_3(AsO_4)_2, 2NaH_2AsO_4, Na_2HAsO_4+13\frac{1}{2}H_2O$, or $16H_2O$. Ppt. (Hirsch.)

$3Cu_3(AsO_4)_2, Na_2HAsO_4 + 9\frac{1}{2}H_2O$. Ppt. (Hirsch.)

$4Cu_3(AsO_4)_2, Na_2HAsO_4 + 11H_2O$. Ppt. (Hirsch.)

Cupric uranyl arsenate, $Cu(UO_2)_2(AsO_4)_2+8H_2O$.

(Werther, A. **68**. 312.)

Min. *Zeunerite*.

Cupric vanadium arsenate, $Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.

See **Arseniovanadate, cupric.**

Cupric arsenate ammonia, $Cu_3(AsO_4)_2, 3NH_3+4H_2O$.

Insol. in cold or hot H_2O. (Damours, J. pr. **37**. 485.)

$2CuO, As_2O_5, 4NH_3+3H_2O$. Decomp. by H_2O. (Schiff, A. **123**. 42.)

Cupric arsenate calcium carbonate, $5CuO, As_2O_5, CaCO_3+4H_2O$, or $9H_2O$.

Min. *Tyrolite*. Easily sol. in acids, and NH_4OH+Aq.

Didymium arsenate, $Di_2H_3(AsO_4)_3$.

Ppt. Insol. in H_2O; sl. sol. in weak acids. (Marignac, A. ch. (3) **38**. 164.)

$5Di_2(AsO_4)_2, As_2O_5+3H_2O$. Ppt.

Glucinum arsenate, $Gl_3(AsO_4)_2$.

Insol. in H_2O; sol. in H_3AsO_4+Aq. (Berzelius.)

Ferrous arsenate, $Fe_3(AsO_4)_2+6H_2O$ (?).

Ppt. Sl. sol. in NH_4OH+Aq. Insol. in $(NH_4)_3AsO_4+Aq$ or other NH_4 salts $+ Aq$. (Wittstein.)

$+8H_2O$. Min. *Symplesite*. Sol. in $HCl+Aq$.

Ferric arsenate, basic, $16Fe_2O_3, As_2O_5+24H_2O$.

Insol. in NH_4OH+Aq. (Berzelius.)

$2Fe_2O_3, As_2O_5+12H_2O$. Insol. in NH_4OH+Aq.

$3Fe_2O_3, 2As_2O_5$.

$3Fe_2(AsO_4)_2, Fe_2O_6H_6+12H_2O$. Min. *Pharmacosiderite*. Easily sol. in acids; decomp. by $KOH+Aq$.

Ferric arsenate, $Fe_2(AsO_4)_2+4H_2O$.

Min. *Scorodite*. Easily sol. in $HCl+Aq$; insol. in HNO_3+Aq.

$+8H_2O$. Insol. in H_2O. When freshly pptd., sol. in NH_4OH+Aq. Sol. in HCl, or HNO_3+Aq. Insol. in $HC_2H_3O_2$, or NH_4 salts $+Aq$. (Wittstein.)

Sol. in warm H_2SO_3+Aq or $(NH_4)_2SO_3+Aq$. (Berthier, A. ch. (3) **7**. 79.)

Ferric arsenate, acid, $2Fe_2O_3, 3As_2O_5+12H_2O$.

Insol. in H_2O or $HC_2H_3O_2+Aq$.

Sol. in mineral acids.

Sol. only in conc. H_3AsO_4+Aq.

Sol. in $(NH_4)_3AsO_4$, and other NH_4 salts $+Aq$. (Wittstein.)

Sol. in NH_4OH+Aq.

Ferroferric arsenate, $6FeO, 3Fe_2O_3, 4As_2O_5+32H_2O$.

Insol. in H_2O. Sol. in $HCl+Aq$. Decomp. by $KOH+Aq$. (Wittstein, J. B. **1866**. 243.)

Ferric lead arsenate, $5Fe_2(AsO_4)_2, Pb_3(AsO_4)_2$.

Min. *Carmine Spar. Carminite*. Sol. in acids; $KOH+Aq$ dissolves out As_2O_5. (Sandberger.)

Ferric potassium arsenate, $2Fe_2O_3, 3K_2O, 3As_2O_5$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

$Fe_2O_3, K_2O, 2As_2O_5$. (Lefèvre.)

Ferric sodium arsenate, $Fe_2O_3, Na_2O, 2As_2O_5$.

(Lefèvre.)

$2Fe_2O_3, 3Na_2O, 3As_2O_5$. (Lefèvre.)

Lanthanum arsenate, $La_2H_3(AsO_4)_3$.

(Frerichs and Smith.)

Doubtful. (Cleve, B. **11**. 910.)

Lead arsenate, $Pb_3(AsO_4)_2$.

Insol. in H_2O, NH_4OH, or NH_4 salts $+Aq$. (Wittstein.)

Sol. in 2703·5 pts. $HC_2H_3O_2+Aq$ containing 38·94 % $HC_2H_3O_2$. (Bertrand, Monit. Scient. (3) **10**. 477.)

Sol. in sat. $NaCl+Aq$. (Becquerel, C. R. **20**. 1523.)

Not pptd. in presence of Na citrate. (Spiller.)

Lead ***pyro*****arsenate,** $Pb_2As_2O_7$.

Insol. in H_2O or $HC_2H_3O_2+Aq$. Sol. in HCl, or HNO_3+Aq. (Rose.)

Decomp. by cold H_2O. (Lefèvre.)

$+H_2O=PbHAsO_4$. Ppt. (Salkowsky, J. pr. **104**. 109.)

Lead potassium arsenate, $PbKAsO_4$.

(Lefèvre, A. ch. (6) **27**. 5.)

Lead sodium arsenate, $PbNaAsO_4$.

(Lefèvre.)

$4PbO, 2Na_2O, 3As_2O_5$. Superficially decomp. by cold H_2O. (Lefèvre.)

Lead arsenate chloride, $3Pb_3(AsO_4)_2, PbCl_2$.

Sol. in dil. HNO_3+Aq. (Lechartier.)

Min. *Mimetite*. Sol. in HNO_3, and KOH+Aq.

Lithium arsenate, Li_3AsO_4.

Ppt. Sol. in dil. acids and in $HC_2H_3O_2$+Aq. (de Schulten, Bull. Soc. (3) **1.** 479.)

$LiH_2AsO_4+\frac{3}{2}H_2O$. Decomp. by H_2O into H_3AsO_4 and Li_3AsO_4. (Rammelsberg, Pogg. **128.** 311.)

Magnesium arsenate, $Mg_3(AsO_4)_2$.

Ppt.

$+8H_2O$. Min. *Hörnesite*. Insol. in H_2O; easily sol. in acids.

Magnesium hydrogen arsenate, $MgHAsO_4$.

$+\frac{1}{2}H_2O$. Insol. in H_2O. (de Schulten, C. R. **100.** 263.)

$+5H_2O$. (Schiefer.)

$+6\frac{1}{2}H_2O$. Insol. in H_2O. 1000 pts. boiling H_2O dissolve 1·5 pts. (Thompson.)

Sol. in HNO_3+Aq before ignition, but insol. in acids after ignition. (Graham, A. **29.** 29.)

$+7H_2O$. Min. *Roesslerite*. Sol. in HCl+Aq.

Magnesium *tetra*hydrogen arsenate, $MgH_4(AsO_4)_2$.

Very deliquescent; sol. in H_2O.

Magnesium potassium arsenate, $MgKAsO_4$.

Insol. in, but decomp. by cold H_2O. (Rose.) Easily sol. in dil. acids. (Lefèvre.)

$4MgO, 2K_2O, 3As_2O_5$. Not attacked by boiling H_2O; slowly sol. in dil. acids. (Lefèvre.)

Magnesium sodium arsenate, $MgNaAsO_4$.

Insol. in H_2O. Very sl. sol. in dil. acids. (Lefèvre.)

$4MgO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Magnesium vanadium arsenate, $MgH_2(VO_2)_2(AsO_4)_2+9H_2O$ and $MgHAsO_4, 2(VO_2)H_2AsO_4+9H_2O$.

See **Arseniovanadate, magnesium.**

Magnesium arsenate chloride, $Mg_3(AsO_4)_2, MgCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Magnesium arsenate fluoride, $Mg_3(AsO_4)_2, MgF_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier.)

Manganous arsenate, basic, $6MnO, As_2O_5+3H_2O$ (?).

Min. *Chondroarsenite*. Easily and completely sol. in dil. HCl, and HNO_3+Aq.

Manganous arsenate, $Mn_3(AsO_4)_2+H_2O$.

Insol. in H_2O; sl. sol. in acids. (Coloriano, C. R. **103.** 273.)

$5MnO, 2As_2O_5+5H_2O$. Insol. in H_2O. (Coloriano.)

$2MnO, As_2O_5$. Sl. decomp. by cold H_2O, but rapidly on heating. (Lefèvre.)

$HMnAsO_4+H_2O$. Decomp. by boiling H_2O into $5MnO, 2As_2O_5+5H_2O$. Sol. in HNO_3, H_2SO_4, or H_3AsO_4+Aq.

Manganous *tetra*hydrogen arsenate, $MnH_4(AsO_4)_2$.

Deliquescent. Easily sol. in H_2O. (Schiefer.)

Manganous potassium arsenate, $MnKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Manganous sodium arsenate, $MnNaAsO_4$.

Very sol. in dil. acids. (Lefèvre.)

$2MnO, 4Na_2O, 3As_2O_5$. Not attacked by boiling H_2O; very sol. in dil. acids. (Lefèvre.)

Manganous arsenate chloride, $Mn_3(AsO_4)_2, MnCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, A. **58.** 259.)

Manganic arsenate, $Mn_2(AsO_4)_2+2H_2O$.

Insol. in H_2O; sol. in acids.

Mercurous arsenate, $(Hg_2)_3(AsO_4)_2$.

Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.) Ppt. (Haack, C. C. **1890,** **2.** 736.)

$Hg_2(AsO_3)_2$. Insol. in H_2O, $HC_2H_3O_2$, or alcohol. Decomp. by cold HCl+Aq. Sl. sol. in cold HNO_3+Aq, from which it is precipitated by NH_4OH as Hg_2HAsO_4. (Simon, Pogg. **41.** 424.)

Mercurous hydrogen arsenate, Hg_2HAsO_4.

Insol. in H_2O, $HC_2H_3O_2$, or NH_4OH+Aq. Decomp. by cold HCl+Aq; sol. in cold HNO_3+Aq without decomp.; very sl. sol. without decomp. in NH_4NO_3+Aq. (Simon, Pogg. **41.** 424.)

Mercuric arsenate, $Hg_3(AsO_4)_2$.

Ppt. Sol. in H_3AsO_4 or HNO_3+Aq. (Bergman.) Very sl. sol. in H_2O. Easily sol. in HCl+Aq. Sl. sol. in HNO_3+Aq. Insol. in H_3AsO_4+Aq. (Haack, C. C. **1890,** **2.** 736.)

Mercurous arsenate nitrate, $Hg_3AsO_4, HgNO_3+H_2O$.

Insol. in H_2O or $HC_2H_3O_2$; sol. in HNO_3+Aq. (Simon, Pogg. **41.** 424.)

$3Hg_3AsO_4, 2HgNO_3, 2Hg_2O$. Ppt. (Haack.)

Molybdenum arsenate.

Ppt.

Nickel arsenate, basic, $5NiO, As_2O_5$.

Min. —— (Bergemann.)

$5NiO, 2As_2O_5+3H_2O$.

$Ni(NiOH)AsO_4$. Difficultly attacked by acids or alkalies. (Coloriano, Bull. Soc. (2) **45.** 241.)

Nickel arsenate, $Ni_3(AsO_4)_2$.

Min. —— (Bergemann.)

$+xH_2O$. Insol. in H_2O. Sol. in H_3AsO_4, and conc. mineral acids. Easily sol. in NH_4OH+Aq.

$+2H_2O$. Insol. in H_2O; difficultly sol. in acids. (Coloriano, Bull. Soc. **45.** 241.)

$+8H_2O$. Min. *Nickel-bloom*, *Annabergite*. Easily sol. in acids.

Nickel potassium arsenate, $12NiO, 3K_2O, 5As_2O_5$. (Lefèvre.)
$2NiO, K_2O, As_2O_5$. Rapidly sol. in dil. acids. (Lefèvre.)

Nickel sodium arsenate, $NiNaAsO_4$.
Very slowly sol. in dil. acids. (Lefèvre.)
$4NiO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Palladium arsenate (?).
Ppt.

Platinum arsenate (?).
Ppt. Sol. in HNO_3+Aq.

Potassium arsenate, K_3AsO_4.
Deliquescent. Very sol. in H_2O. (Graham, Pogg. **32.** 47.)

Potassium hydrogen arsenate, K_2HAsO_4.
Sol. in H_2O.

Potassium *di*hydrogen arsenate, KH_2AsO_4.
Sol. in 5·3 pts. H_2O at 6°, forming a solution of sp. gr. 1·1134. Much more sol. in hot H_2O. Insol. in alcohol.

Sol. in 26·666 pts. boiling conc. alcohol. (Wenzel.)

Potassium sodium hydrogen arsenate, $KNaHAsO_4+16H_2O$.
Sol. in H_2O.
$K_2Na_2H_6(AsO_4)_4+9H_2O$. Sol. in H_2O, and not easily decomp. thereby into its constituents. (Filhol and Senderens, C. R. **95.** 343.)

Potassium strontium arsenate, $KSrAsO_4$. (Lefèvre, C. R. **108.** 1058.)

Potassium vanadium arsenate, $(VO_2)_2KAsO_4+2\frac{1}{2}H_2O$.
See **Arseniovanadate, potassium.**

Potassium zinc arsenate, $KZnAsO_4$. (Lefèvre.)

Rhodium arsenate (?).
Ppt.

Silver arsenate, Ag_3AsO_4.
Insol. in H_2O. Sol. in acids; easily sol. in H_3AsO_4+Aq. (Joly, C. R. **103.** 1071.)
Sol. in NH_4OH+Aq. (Scheele.)
Sol. in $(NH_4)_2CO_3$+Aq. Insol. in NH_4 sulphate, nitrate, or succinate+Aq. (Wittstein.)
Very sl. sol. in NH_4NO_3+Aq, more easily in $HC_2H_3O_2$+Aq. (Graham.)
Sol. in $Na_2S_2O_3$+Aq, but not so easily as Ag_3PO_4. Not pptd. in presence of Na citrate. (Spiller.)

Silver hydrogen arsenate, Ag_2HAsO_4.
Decomp. by H_2O, with formation of Ag_3AsO_4. (Setterberg, Berz. J. B. **26.** 208.)
AgH_2AsO_4. Decomp. by H_2O. (Joly, C. R. **103.** 1071.)
$Ag_2O, 2As_2O_5$. Decomp. by H_2O. Rather sl. sol. in HNO_3+Aq. Very easily sol. in NH_4OH+Aq. (Hurtzig and Geuther, A. **111.** 168.)

Silver arsenate ammonia, $Ag_3AsO_4, 4NH_3$.
Easily sol. in H_2O. (Widmann, Bull. Soc. (2) **20.** 64.)

Silver arsenate sulphate, $3Ag_2O, As_2O_5, SO_3$.
Decomp. by H_2O, with separation of Ag_3AsO_4; decomp. by dil. H_2SO_4+Aq. (Setterberg, Berz. J. B. **26.** 209.)

Sodium arsenate, $Na_3AsO_4+12H_2O$.
Permanent in dry air. Sol. in 3·57 pts. H_2O at 15·5°. (Graham.) 100 pts. H_2O at 15·5° dissolve 28 pts. $Na_3AsO_4+12H_2O$. (Berzelius.) Sol. in 3·75 pts. H_2O at 17°; or 100 pts. H_2O at 17° dissolve 26·7 pts.; or sat. Na_3AsO_4+Aq at 17° contains 21·1 % $Na_3AsO_4+12H_2O$ or 10·4 % Na_3AsO_4, and has sp. gr. 1·1186. (Schiff, A. **113.** 350.)
Melts in crystal H_2O at 85·5°.

Sp. gr. of Na_3AsO_4+Aq at 17°.
% = % $Na_3AsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·0053	9	1·0490	17	1·0945
2	1·0107	10	1·0547	18	1·1003
3	1·0161	11	1·0603	19	1·1061
4	1·0215	12	1·0659	20	1·1121
5	1·0270	13	1·0716	21	1·1179
6	1·0325	14	1·0773	22	1·1238
7	1·0380	15	1·0830	...	...
8	1·0435	16	1·0887	...	...

(Schiff, calculated by Gerlach, Z. anal. **8.** 286.)

"Arseniate of soda" dissolves in 60 pts. boiling alcohol. (Wenzel.)

$+4\frac{1}{2}H_2O$. (Hall, Chem. Soc. **51.** 93.)
$+10H_2O$. Efflorescent. (Hall.)

Sodium hydrogen arsenate, $Na_2HAsO_4+12H_2O$.
Efflorescent. Sol. in H_2O; sol. in 1·79 pts. H_2O at 14°; or 100 pts. H_2O at 14° dissolve 56 pts. $Na_2HAsO_4+12H_2O$. Sat. Na_2HAsO_4+Aq contains 35·9 % $Na_2HAsO_4+12H_2O$, or 16·5 % Na_2HAsO_4, and has sp. gr. = 1·1722. (Schiff, A. **113.** 350.)

100 pts. H_2O at 7·2° dissolve 22·268 pts. (Thompson.)

100 pts. H_2O dissolve 17·2 pts. $Na_2HAsO_4+12H_2O$ at 0°, and 140·7 pts. at 30°. (Tilden, Chem. Soc. **45.** 409.)
Melts in crystal H_2O at 28°. (Tilden.)

Sp. gr. of Na_2HAsO_4+Aq at 14°.
% = % $Na_2HAsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·0042	15	1·0665	29	1·1358
2	1·0084	16	1·0712	30	1·1410
3	1·0126	17	1·0759	31	1·1463
4	1·0168	18	1·0807	32	1·1516
5	1·0212	19	1·0855	33	1·1569
6	1·0256	20	1·0904	34	1·1623
7	1·0300	21	1·0953	35	1·1677
8	1·0344	22	1·1003	36	1·1731
9	1·0389	23	1·1052	37	1·1786
10	1·0434	24	1·1103	38	1·1841
11	1·0479	25	1·1153	39	1·1896
12	1·0525	26	1·1204	40	1·1952
13	1·0571	27	1·1255	...	...
14	1·0618	28	1·1306	...	...

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Insol. in alcohol.
$+7H_2O$. Not efflorescent. (Schiff.)
$+7\frac{1}{2}H_2O$. (Lescoeur, C. R. **104.** 1171.)
$+13\frac{1}{2}H_2O$. (Setterberg.)

Sodium *di*hydrogen arsenate, $NaH_2AsO_4 + H_2O$.

More sol. in H_2O than Na_3AsO_4 or Na_2HAsO_4. (Schiff.)
$+2H_2O$. Efflorescent. (Joly and Duffet, C. R. **102.** 1391.)

Sodium *tri*hydrogen *di*arsenate, $Na_3H_3(AsO_4)_2 + 3H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **95.** 343.)

Sodium strontium arsenate, $NaSrAsO_4$.

Not attacked by boiling H_2O. (Lefèvre.)
$+9H_2O$. Scarcely sol. in H_2O. (Joly, C. R. **104.** 905.)
$+18H_2O$. (Joly.)

Sodium uranyl arsenate, $Na(UO_2)AsO_4$.

Ppt. (Werther, A. **68.** 312.)

Sodium zinc arsenate, $NaZnAsO_4$.

Slowly sol. in dil. acids. (Lefèvre.)
$Na_2ZnAs_2O_7$. As above. (Lefèvre.)

Sodium arsenate fluoride, Na_3AsO_4, $NaF + 12H_2O$.

Sol. in 9·5 pts. H_2O at 25°, and 2 pts. at 75°. (Briegleb, A. **97.** 95.)

Sodium arsenate stannate, $6Na_2O$, $2As_2O_5$, $SnO_2 + 50H_2O$.

More difficultly sol. than sodium stannate. (Haeffely, Phil. Mag. (4) **10.** 290.)

Sodium arsenate sulphate, $Na_8As_6O_{19}$, $2Na_2SO_4$.

Sol. in H_2O. (Mitscherlich.)
$Na_4As_2O_7$, Na_2SO_4. (Setterberg.)

Sodium arsenate tungstate, $Na_4As_2O_7, Na_2W_3O_{10} + 20H_2O$.

Very easily sol. in H_2O. (Lefort, C. R. **92.** 1461.)

Strontium arsenate, $Sr_3(AsO_4)_2$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Strontium *pyro*arsenate, $Sr_2As_2O_7$.

Decomp. by cold H_2O into $SrHAsO_4 + 1\frac{1}{2}H_2O$. (Lefèvre.)

Strontium hydrogen arsenate, $SrHAsO_4 + 1\frac{1}{2}H_2O$.

Insol. in cold, but decomp. by hot H_2O into a basic, and a sol. acid salt. 100 pts. H_2O at 15·5° dissolve 0·284 pt. (Thompson, **1831.**)
Sol. in $HC_2H_3O_2$, and very easily in $HCl + Aq$. (Kotschoubey, J. pr. **49.** 182.)
Sol. in $HNO_3 + Aq$.

Strontium vanadium arsenate, $SrHAsO_4 + 2(VO_2)H_2AsO_4 + 7\frac{1}{2}H_2O$.

See **Arseniovanadate, strontium.**

Strontium arsenate chloride, $3Sr_3(AsO_4)_2$, $SrCl_2$.

Insol. in H_2O; easily sol. in dil. $HNO_3 + Aq$. (Lechartier, C. R. **65.** 172.)

Thallous arsenate, Tl_3AsO_4.

Sol. in H_2O. (Willm, A. ch. (4) **5.** 5.)

Thallous hydrogen arsenate, Tl_2HAsO_4.

Very easily sol. in H_2O. (Willm.)

Thallous *di*hydrogen arsenate, TlH_2AsO_4.

Easily sol. in H_2O. (Willm.)

Thallic arsenate, $TlAsO_4 + 2H_2O$.

Insol. in H_2O; sol. in $HCl + Aq$; decomp. by NH_4OH, or $KOH + Aq$. (Willm.)

Thorium arsenate, $ThHAsO_4$.

Insol. in H_2O or $H_3AsO_4 + Aq$. (Berzelius.)

Stannous arsenate, $SnHAsO_4 + \frac{1}{2}H_2O$.

Insol. in H_2O. (Lenssen, A. **114.** 113.)

Stannic arsenate, $2SnO_2$, As_2O_5.

Ppt. Insol. in H_2O and dil. $HNO_3 + Aq$. (Haeffely, Phil. Mag. (4) **10.** 290.)
$Sn_3(AsO_4)_4 + 6H_2O$. Insol. in H_2O; sol. in conc. $HCl + Aq$, and in aqua regia; insol. in $HNO_3 + Aq$ or H_2SO_4. (Williams, Proc. Soc. Manchester, **15.** 67.)
Colloidal. Very slowly sol. in H_2O, from which it is pptd. by HCl, HNO_3, or $H_2SO_4 + Aq$; also by $BaCl_2$, $CaCl_2$, NH_4Cl, and $FeCl_3 + Aq$, and by $AgNO_3$, or $KI + Aq$. Not pptd. by alcohol, $HC_2H_3O_2$, $HgCl_2$, Na_2CO_3, K_2CO_3, or $(NH_4)_2CO_3 + Aq$. The pptd. jelly is readily sol. in conc. acids, and KOH, or $NaOH + Aq$. (Williams, *l.c.*)

Stannous arsenate chloride, $Sn_3(AsO_4)_2$, $SnCl_2 + 2H_2O$.

Decomp. on air. (Lenssen, A. **114.** 113.)

Titanium arsenate (?).

Insol. in H_2O. Sol. in titanic acid, arsenic acid, or $HCl + Aq$. Sol. in Ti salts + Aq. (Rose.)

Uranous arsenate, $U_3(AsO_4)_2$.

Ppt.

Uranous hydrogen arsenate, $UHAsO_4 + 1\frac{1}{2}H_2O$.

Ppt. Sol. in $HCl + Aq$.

Uranyl arsenate, $(UO_2)HAsO_4 + 4H_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions, as $NH_4Cl + Aq$; sol. in the mineral acids; sol. in $K_2CO_3 + Aq$. (Ebelmen, A. ch. (3) **5.** 220.)
$(UO_2)_2As_2O_7$. Insol. in H_2O; sol. in acids.
$(UO_2)_3(AsO_4)_2 + 12H_2O$.
Min. *Troegerite.*

Vanadium *di*hydrogen arsenate, $(VO_2)H_2AsO_4 + 4H_2O$.

Easily sol. in H_2O. (Friedheim, B. **23.** 2600.)
See **Arseniovanadic acid.**

Vanadium zinc arsenate, $(VO_2)_2ZnH_2(AsO_4)_2 + 5\frac{1}{2}H_2O$, and $2(VO_2)H_2AsO_4 + 6\frac{1}{2}H_2O$.

See **Arseniovanadate, zinc.**

Vanadyl arsenate, $(VO)_2HAsO_4 + H_2O$.

Very slowly sol. in H_2O; insol. in alcohol; easily sol. in $HCl + Aq$. (Berzelius.)

Composition given by Friedheim (B. **23.** 2600).

Yttrium arsenate, $YtHAsO_4$.

Ppt. Insol. in acetic, easily sol. in mineral acids.

Zinc arsenate, basic, $4ZnO, As_2O_5+H_2O$.

(Friedel, J. B. **1866.** 949.)

Min. *Adamite.* Easily sol. in dil. $HCl+Aq$, and is attacked by $HC_2H_3O_2$.

Zinc arsenate, $Zn_3(AsO_4)_2+3H_2O$.

Ppt. Sol. in HNO_3, and H_3AsO_4+Aq. (Köttig, J. pr. **48.** 182.)

$+8H_2O$.

Min. *Köttigite.*

Zinc arsenate, acid, $5ZnO, 2As_2O_5$.

Insol. in H_2O; sol. in H_3AsO_4, or HNO_3+Aq. (Mitscherlich.)

$+5H_2O$. (Demel, B. **12.** 1279.)

$2ZnO, As_2O_5$. Very slowly decomp. by cold, rapidly by boiling H_2O. (Lefèvre.)

$ZnHAsO_4+H_2O$. Insol. in H_2O. (Debray, Bull. Soc. (2) **2.** 14.)

Decomp. by hot H_2O into $4ZnO, As_2O_5+H_2O$. (Coloriano, C. R. **103.** 273.)

Zinc arsenate ammonia, $Zn_3(AsO_4)_2, 2NH_3+3H_2O$.

Insol. in H_2O; sol. in acids, NH_4OH, or $KOH+Aq$. (Bette, A. **15.** 141.)

Zirconium arsenate, $2ZrO_2, As_2O_5+\frac{5}{2}H_2O=(ZrO)HAsO_4+\frac{3}{4}H_2O$.

Ppt. Insol. in H_2O or $HCl+Aq$. (Paykull, B. **6.** 1467.)

Arsenioarsenic acid, $3As_2O_3, 2As_2O_5+3H_2O$.

Decomp. by H_2O. (Joly, C. R., **100.** 1221.)

$3As_2O_3, As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

$As_2O_3, As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

See also **Arsenic** *tri***oxide** *pent***oxide.**

Arseniomolybdic acid, $As_2O_5, 18MoO_3+30H_2O$.

Sol. in H_2O. Solution sat. at 18·3° has sp. gr. 2·45, and contains 2·16 g. dissolved in 1 ccm. H_2O. K salt is difficultly sol., Na, NH_4, Co, Ni, and Cu salts are easily sol. in H_2O. (Pufahl, B. **17.** 217.)

Sol. in ether with subsequent separation into two layers. *See* Phosphotungstic acid. (Drechsel, B. **20.** 1452.)

$3H_2O, 7MoO_3, As_2O_5+11H_2O$. (Seyberth, B. **7.** 391.)

$3H_2O, 20MoO_3, As_2O_5+24H_2O$. Sl. sol. in HNO_3+Aq. (Debray, C.R. **78.** 1408.)

$3H_2O, 6MoO_3, As_2O_5+13H_2O$. Sol. in H_2O. (Debray.)

Ammonium arseniomolybdate, $3(NH_4)_2O, As_2O_5, 24MoO_3+6H_2O$.

Insol. in H_2O, HNO_3, dil. H_2SO_4+Aq, and in solutions of salts when $(NH_4)_2MoO_4$ and HNO_3 are in excess. (Seligsohn, J. pr. **67.** 481.)

$5(NH_4)_2O, H_2O, As_2O_5, 16MoO_3+8H_2O$. Nearly insol. in cold, sol. in boiling H_2O. Easily sol. in NH_4OH+Aq. (Gibbs, Am. Ch. J. **3.** 402.)

$(NH_4)_2O, 2H_2O, 7MoO_3, As_2O_5+4H_2O$. Sol. in hot H_2O. (Seyberth, B. **7.** 391.)

Not obtained. (Pufahl.)

$20MoO_3, 3(NH_4)_2O, As_2O_5$. Easily sol. in H_2O. (Debray, C. R. **78.** 1408.)

$6MoO_3, 4(NH_4)_2O, As_2O_5+xH_2O$. Sl. sol. in cold H_2O; sol. in acids. (Debray.)

Not obtained. (Pufahl.)

$6MoO_3, (NH_4)_2O, As_2O_5+2H_2O$. Sl. sol. in cold H_2O; sol. in acids. (Debray.)

$+4H_2O$. (Pufahl, Leipzig, **1888.**)

$2(NH_4)_2O, 4H_2O, As_2O_5, 18MoO_3+13H_2O$. (Pufahl.)

Barium arseniomolybdate, $3BaO, As_2O_5, 7MoO_3$.

Ppt. (Seyberth.)

$BaO, 2H_2O, As_2O_5, 6MoO_3+8H_2O$. (Pufahl.)

Cadmium arseniomolybdate, $CdO, 2H_2O, As_2O_5, 6MoO_3+11H_2O$.

(Pufahl.)

$3CdO, 3H_2O, As_2O_5, 18MoO_3+33H_2O$. (Pufahl.)

Calcium arseniomolybdate, $CaO, 2H_2O, As_2O_5, 6MoO_3+8H_2O$.

(Pufahl.)

$3CaO, 3H_2O, As_2O_5, 18MoO_3+29H_2O$. (Pufahl.)

Cobalt arseniomolybdate, $CoO, 2H_2O, As_2O_5, 6MoO_3+11H_2O$.

(Pufahl.)

$3CoO, 3H_2O, As_2O_5, 18MoO_3+33H_2O$. (Pufahl.)

Cupric arseniomolybdate, $CuO, 2H_2O, As_2O_5, 6MoO_3+15H_2O$. (Pufahl.)

$3CuO, 3H_2O, As_2O_5, 18MoO_3+34H_2O$. (Pufahl.)

Lithium arseniomolybdate, $Li_2O, As_2O_5, MoO_3+14H_2O$.

(Pufahl, **1888.**)

$3Li_2O, 3H_2O, As_2O_5, 18Mo_3+31H_2O$. (Pufahl.)

Magnesium arseniomolybdate, $MgO, 2H_2O, As_2O_5, 6MoO_3+11H_2O$.

(Pufahl.)

$3MgO, 3H_2O, As_2O_5, 18MoO_3+33H_2O$. (Pufahl.)

Manganese arseniomolybdate, $MnO, 2H_2O, As_2O_5, 6MoO_3+11H_2O$.

(Pufahl.)

$3MnO, 3H_2O, As_2O_5, 6MoO_3+33H_2O$. (Pufahl.)

Nickel arseniomolybdate, $NiO, 2H_2O, As_2O_5, 6MoO_3+11H_2O$.

(Pufahl.)

$3NiO, 3H_2O, As_2O_5, 18MoO_3+34H_2O$. (Pufahl.)

Potassium arseniomolybdate, $K_2O, As_2O_5, 2MoO_3+5H_2O$.

Sol. in H_2O. (Friedheim, Z. anorg. **2.** 314.)

K_2O, As_2O_5, $6MoO_3+5H_2O$. Difficultly sol. in H_2O. (Pufahl, **1888.**)

$3K_2O$, As_2O_5, $6MoO_3+xH_2O$. (Pufahl.)

$3K_2O$, $3H_2O$, As_2O_5, $18MoO_3+25H_2O$. (Pufahl.)

K_2O, $5H_2O$, As_2O_5, $18MoO_3+21H_2O$. (Pufahl.)

$3K_2O$, As_2O_5, $20MoO_3$. Insol. in H_2O. (Debray, C. R. **78.** 1408.)

Silver arseniomolybdate, $3Ag_2O$, As_2O_5, $7MoO_3$.

Ppt. (Seyberth.)

$3Ag_2O$, As_2O_5, $6MoO_3+xH_2O$. (Pufahl, Leipzig, **1888.**)

$3Ag_2O$, As_2O_5, $18MoO_3+22H_2O$.

$7Ag_2O$, $5H_2O$, $2As_2O_5$, $36MoO_3+25H_2O$.

Sodium arseniomolybdate, Na_2O, As_2O_5, $2MoO_3+8H_2O$.

(Friedheim, Z. anorg. **2.** 314.)

Na_2O, As_2O_5, $6MoO_3$. Sol. in H_2O. (Debray, C. R. **78.** 1408.)

$+12H_2O$. (Pufahl.)

$3Na_2O$, As_2O_5, $6MoO_3+xH_2O$. (Pufahl.)

$+11H_2O$. (Friedheim, Z. anorg. **2.** 314.)

$3Na_2O$, $3H_2O$, As_2O_5, $18MoO_3+21H_2O$. (Pufahl.)

Strontium arseniomolybdate, SrO, $2H_2O$, As_2O_5, $6MoO_3+8H_2O$.

(Pufahl.)

$3SrO$, $3H_2O$, As_2O_5, $18MoO_3+29H_2O$. (Pufahl.)

Thallium arseniomolybdate, $6Tl_2O$, As_2O_5, $18MoO_3+xH_2O$.

(Pufahl.)

$3Tl_2O$, $3H_2O$, As_2O_5, $18MoO_3+3H_2O$. (Pufahl.)

Zinc arseniomolybdate, ZnO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3ZnO$, $3H_2O$, As_2O_5, $18MoO_3+34H_2O$. (Pufahl.)

Arseniosulphuric acid.

See **Arsenic sulphur *tri*oxide.**

Arseniotungstic acid, $3H_2O$, As_2O_5, $16WO_3+32H_2O=H_3AsW_8O_{28}+16H_2O$($\alpha$-anhydroarsenioluteotungstic acid).

Sol. in H_2O. (Kehrmann, A. **245.** 45.)

$3H_2O$, As_2O_5, $19WO_3$ (?). Sp. gr. of sat. solution in H_2O is 3·279. (Fremery, B. **17.** 296.)

Is a mixture containing principally $H_3AsW_8O_{28}+16H_2O$. (Kehrmann.)

Ammonium arseniotungstate, $4(NH_4)_2O$, $2H_2O$, As_2O_5, $6WO_3+3H_2O$.

Sl. sol. in cold H_2O or HNO_3+Aq; easily sol. in boiling H_2O. (Gibbs, Proc. Am. Acad. **16.** 135.)

$3(NH_4)_2O$, As_2O_5, $16WO_3+16H_2O=(NH_4)_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$3(NH_4)_2O$, As_2O_5, $19WO_3+18H_2O$ (?). Sol. in H_2O. (Fremery, B. **17.** 296.)

Barium arseniotungstate, $2BaO$, As_2O_5, $16WO_3+xH_2O$.

Sol. in H_2O. (Péchard, A. ch. (6) **22.** 262.)

Potassium arseniotungstate, $3K_2O$, $3H_2O$, As_2O_5, $6WO_3$.

Insol. in H_2O. Readily sol. in alkali hydroxides + Aq. (Gibbs.)

$3K_2O$, As_2O_5, $16WO_3+16H_2O=K_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$3K_2O$, As_2O_5, $19WO_3+16H_2O$ (?). Sol. in H_2O. (Fremery.)

Silver arseniotungstate, $Ag_5AsW_8O_{29}$.

Insol. in H_2O (Kehrmann, A. **245.** 55); perhaps identical with—

$6Ag_2O$, As_2O_5, $16WO_3+11H_2O$. Insol. in H_2O. (Gibbs.)

Sodium arseniotungstate, $3Na_2O$, As_2O_5, $3WO_3+20H_2O$.

Very sol. in H_2O. (Lefort, C. R. **92.** 1461.)

Arsenious acid.

Known only as solution of As_2O_3 in H_2O.

Arsenites.

All arsenites, except those of the alkali metals, are partially or wholly insol. in H_2O, but easily sol. in acids; several are sol. in $(NH_4)_2SO_4$, NH_4NO_3, or NH_4Cl+Aq.

All basic arsenites are sol. in acids except those that give an insol. salt with the bases. Many are sol. in excess of As_2O_3+Aq.

Ammonium arsenite, NH_4AsO_2.

Very sol. in H_2O. (Luynes, J. pr. **72.** 180.)

$(NH_4)_4As_2O_5$. Very sol. in H_2O. Insol. in alcohol or ether. (Stein, A. **74.** 218.)

Ammonium arsenite bromide, $2As_2O_3$, NH_4Br.

Sl. sol. in H_2O. (Rüdorff, B. **19.** 2679.)

Ammonium arsenite chloride, As_2O_3, NH_4Cl.

Sl. sol. in H_2O. Sol. in warm dil. NH_4OH+Aq. (Rüdorff.)

Ammonium arsenite iodide, $2As_2O_3$, NH_4I.

Sl. sol. in boiling H_2O. Sol. in warm dil. NH_4OH+Aq. (Rüdorff.)

Antimony arsenite (?).

Ppt. Sol. in a small amount H_2O, but insol. in a large quantity. (Berzelius.)

Completely sol. in $KOH+Aq$. (Reynolds.)

Barium arsenite, $Ba(AsO_2)_2$.

Easily sol. in H_2O when recently pptd., but insol. after being dried. Pptd. from aqueous solution by boiling. (Filhol, A. **68.** 308.)

$BaH_4(AsO_3)_2$. Ppt. (Bloxam, Chem. Soc. **15.** 281.)

$Ba_2As_2O_5+4H_2O$. Sl. sol. in H_2O; also somewhat sol. in alcohol. (Stein, A. **74.** 218.)

Sl. sol. in H_3AsO_4+Aq and BaO_2H_2+Aq. (Dumas.)

Sol. in NH_4Cl+Aq. (Wackenroder, A. **41.** 316.)

Not pptd. from solutions containing Na citrate. (Spiller.)

Cæsium arsenite bromide, As_2O_3, $CsBr$.

Sol. in H_2O. (Wheeler, Z. anorg. **4.** 451.)

Cæsium arsenite chloride, As_2O_3, $CsCl$.

As above.

Cæsium arsenite iodide, As_2O_3, CsI.

As above.

Calcium arsenite, $Ca(AsO_2)_2$.

Somewhat sol. in H_2O; sol. in $Ca(OH)_2$+Aq or As_2O_3+Aq. (Simon, Pogg. **47.** 417.)

$3CaO, 2As_2O_3+3H_2O$. Sl. sol. in H_2O; easily sol. in NH_4Cl+Aq; sol. in As_2O_3+Aq. (Stein.)

$2CaO, As_2O_3+H_2O$. Mixture of basic salts. (Stein, A. **74.** 218.)

Sl. sol. in H_2O; insol. in H_2O containing CaO_2H_2. (Berzelius.)

Not pptd. in presence of 4000-5000 pts. H_2O. (Harting. Lassaigne.)

Not pptd. from solutions containing NH_4 salts; and when pptd. is sol. in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Gieseke and Schweigger.)

Sol. in NH_4AsO_2+Aq. (Schweigger.)

Sol. in $CaCl_2$+Aq. (Ordway.)

Easily sol. in dil. acids. Not pptd. from solutions containing sodium citrate. (Spiller.)

$Ca_3(AsO_3)_2$. Ppt. (Kühn, J. B. **1852.** 379.)

Chromic arsenite, $CrAsO_3$.

Sol. in H_2O, but slowly decomp. by boiling. (Neville, C. N. **34.** 220.)

Cobaltous arsenite, $3CoO, 2As_2O_3$.

Decomp. by HCl+Aq. Sol in HNO_3+Aq. (Girard, C. R. **34.** 918.)

Cobaltous hydrogen arsenite, $Co_3H_6(AsO_3)_4$.

Insol. in H_2O; sol. in HNO_3, HCl, or NH_4OH+Aq. (Proust.)

Only sol. in KOH, or NaOH+Aq when formed in a solution containing an excess of those reagents. (Reynoso, C. R. **31.** 68.)

Cupric arsenite, $CuHAsO_3$.

(Scheele's green.) Insol. in H_2O; sol. in KOH+Aq, NH_4OH+Aq, and in most acids. Formula is $Cu_3(AsO_3)_2+2H_2O$. (Sharples, C. N. **35.** 89.)

$xCuO, yAs_2O_3$. Min. *Trippkëite.* Easily sol. in HNO_3 and in HCl+Aq.

Didymium arsenite, $Di_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Ferrous arsenite, $Fe_2As_2O_5$.

Ppt. Sol. in NH_4OH+Aq; insol. in NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

Ferric arsenite, basic, $4Fe_2O_3, As_2O_3+5H_2O$.

Ppt. H_2O extracts As_2O_3. Sol. in conc. acids with separation of As_2O_3. Acetic acid is without action. (Bunsen and Berthold, **1834.**)

Sol. in KOH, or NaOH+Aq.

$2FeAsO_3, Fe_2O_3+7H_2O$. Sol. in NaOH, and KOH+Aq.

"Ferric arsenite" is sl. sol. in $Al_2(SO_4)_3$+Aq. (Kynaston, Dingl. **235.** 326.)

Lanthanum arsenite, $La_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Lead arsenite, $Pb(AsO_2)_2+xH_2O$.

Sl. sol. in H_2O. Insol. in KOH, but sol. in NaOH+Aq. (Berzelius.)

$Pb_2As_2O_5$. Insol. in H_2O, NH_4OH, NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

$Pb_3(AsO_3)_2$. Scarcely sol. in H_2O; easily sol. in HNO_3, or $HC_2H_3O_2$+Aq. Boiling H_2O dissolves some As_2O_3. Not completely insol. in KOH+Aq. (Streng, A. **129.** 238.)

Lead arsenite chloride, $Pb_5As_2O_8, 2PbCl_2$.

Min. *Ekdemite.* Easily sol. in HNO_3+Aq, and warm HCl+Aq.

Magnesium arsenite, $Mg_3(AsO_3)_2$.

Insol. in NH_4OH+Aq, but sol. in a large excess of NH_4Cl+Aq. (Rose.)

$MgHAsO_3+H_2O$. Ppt. (Bloxam, Chem. Soc. **15.** 281.)

Manganous arsenite, $3MnO, 2As_2O_3+5H_2O=H_6Mn_3(AsO_3)_4+2H_2O$.

Ppt.

Mercurous arsenite (?).

Insol. in H_2O; sol. in HNO_3+Aq.

Mercuric arsenite (?).

Sol. in HNO_3, or potassium arsenite+Aq.

Nickel arsenite, $3NiO, 2As_2O_3+4H_2O$.

Insol. in H_2O; sol. in NH_4OH+Aq. (Proust.)

Sol. in KOH+Aq. (Girard, C. R. **34.** 918.)

$2NiO, As_2O_3$. Insol. in H_2O; sol. in NH_4OH+Aq; sol. in KOH+Aq. (Reynoso, C. R. **31.** 68.)

Potassium arsenite, basic, $K_4As_2O_5=2K_2O, As_2O_3$.

Very sol. in H_2O. (Bloxam.)

Potassium arsenite, $KAsO_2$.

Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Potassium hydrogen arsenite, $KH(AsO_2)_2+H_2O$.

Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Potassium arsenite bromide, $4As_2O_3, 2KBr$.

More sol. in H_2O than iodide. (Schiff and Sestini, A. **228.** 72.)

$2As_2O_3, KBr$. (Rüdorff, B. **19.** 2675.)

Potassium arsenite chloride, $2As_2O_3, KCl$.

Much more quickly sol. in hot H_2O than bromide or iodide. (Rüdorff, B. **19.** 2675.)

As_2O_3, KCl. Decomp. by H_2O.

Potassium arsenite iodide, $3As_2O_3, 2KI+H_2O$.

Sl. sol. in cold H_2O; sol. in 20 pts. boiling, and 40 pts. cold H_2O. (Emmet, Sill. Am. J. (2) **18.** 583.)

$6KAsO_2, 2KI+3H_2O$. Sol. in H_2O and alcohol. Decomp. by acids. (Harms.)

$2KH(AsO_2)_2, As_2O_3, 2KI$. Sl. sol. in H_2O. (Harms, A. **91.** 371.)

$4As_2O_3, 2KI+4As_2O_3, 2KI, H_2O$. Sol. in 40 pts. cold, 20 pts. hot H_2O; sol. in alkalies. (Schiff and Sestini, A. **228.** 72.)

$2As_2O_3, KI$. Very difficultly sol. even in boiling H_2O. Very easily sol. in KOH+Aq, but much less so in K_2CO_3+Aq. (Rüdorff, B. **19.** 2670.)

Rubidium arsenite bromide, As_2O_3, RbBr.

Decomp. by H_2O. (Wheeler, Z. anorg. **4.** 451.)

Rubidium arsenite chloride, As_2O_3, RbCl.

As above.

Rubidium arsenite iodide, As_2O_3, RbI.

As above.

Silver arsenite, Ag_3AsO_3.

Insol. in H_2O. Not pptd. in presence of 20,000 pts. H_2O. (Harting.)

Easily sol. in HNO_3+Aq and other acids. (Marcet.)

More easily sol. in $HC_2H_3O_2$+Aq than Ag_3PO_4; sl. sol. in $HC_2H_3O_2$+Aq. (Santos, C. N. **38.** 94.)

Insol. in KOH+Aq. (Kühn, Arch. Pharm. (2) **69.** 267.)

Easily sol. in NH_4OH+Aq. (Marcet.)

Insol. in NH_4OH+Aq, but sol. therein in presence of alkali nitrates. (Santos, *l.c.*)

Incompletely sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Wittstein, Repert. **51.** 41.)

Decomp. by NH_4Cl+Aq. Sol. in $KAsO_2$+Aq. (Kühn, *l.c.*)

Not pptd. in solutions containing sol. citrates. (Spiller.)

$2Ag_2O$, As_2O_3. Ppt. (Pasteur, J. Pharm. (3) **13.** 395.)

$3Ag_2O$, $2As_2O_3$. Sol. in cold $HC_2H_3O_2$+Aq. (Santos.)

Sol. in NH_4OH + Aq and in potassium arsenite +Aq. (Girard, C. R. **34.** 918.)

Silver arsenite ammonia, $2Ag_2O$, As_2O_3, $4NH_3$.

Insol. in H_2O or alcohol. (Girard.)

Sodium arsenites.

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol. in H_2O. (Pasteur, A. **68.** 308.)

Sodium arsenite bromide, $2As_2O_3$, NaBr.

Decomp. by warm H_2O. (Rüdorff, B. **21.** 3052.)

Sodium arsenite iodide, $2As_2O_3$, NaI.

Decomp. by hot H_2O. (Rüdorff.)

Strontium arsenite, $Sr(AsO_2)_2+4H_2O$.

Quite easily sol. in H_2O. (Stein.)

Sl. sol. in H_2O, SrO_2H_2+Aq, or H_3AsO_4+Aq. (Dumas.)

Very sl. sol. in alcohol. (Stein.)

Stannous arsenite (?).

Ppt.

Stannic arsenite (?).

Insol. in H_2O.

Zinc arsenite, $Zn_3(AsO_3)_2$.

Ppt.

Arseniovanadic acid, As_2O_5, $V_2O_5+2H_2O$.

Easily sol. in H_2O, but solution easily decomposes; crystallises from H_2O with $10H_2O$. Composition is vanadium dihydrogen arsenate $(VO_2)H_2AsO_4$. (Friedheim, B. **23.** 2600.)

+14, and $+18H_2O$. (Ditte, C. R. **102.** 757.) Could not be obtained. (Friedheim.)

$3As_2O_5$, $2V_2O_5$. (Berzelius.) Correct formula is as above. (Friedheim.)

$3H_2O$, $7As_2O_5$, $6V_2O_5$. (Gibbs, Am. Ch. J. **7.** 209.) Could not be obtained. (Friedheim.)

$3H_2O, 5As_2O_5, 8V_2O_5+24H_2O$. (Gibbs.) Could not be obtained. (Friedheim.)

Ammonium arseniovanadate, $(NH_4)_2O$, $2V_2O_5$, $As_2O_5+5H_2O$.

Efflorescent in dry air; sl. sol. in cold, decomp. by hot H_2O. Composition is ammonium divanadium arsenate = $(VO_2)_2(NH_4)AsO_4 + 2\frac{1}{2}H_2O$. (Friedheim, B. **23.** 2600.)

$2(NH_4)_2O$, $2V_2O_5$, $3As_2O_5+4H_2O$. Cannot be crystallised from H_2O. Composition is $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$. (Friedheim.)

$5(NH_4)_2O$, $4As_2O_5$, $2V_2O_5+18H_2O$. Sol. in H_2O. (Ditte, C. R. **102.** 1019.) Does not exist. (Friedheim, B. **23.** 2605.)

Calcium arseniovanadate, $2CaO$, $2V_2O_5$, $3As_2O_5 + 21H_2O = CaHAsO_4 + 2(VO_2)H_2AsO_4 + 8H_2O$.

Can be crystallised in presence of vanadic acid without decomp. (Friedheim.)

Cobalt arseniovanadate, CoO, V_2O_5, $As_2O_5+9H_2O=Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

Sol. in H_2O. (Friedheim.)

Copper arseniovanadate, CuO, V_2O_5, $As_2O_5+4H_2O=Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.

Sol. in H_2O. (Friedheim.)

Magnesium arseniovanadate, MgO, V_2O_5, $As_2O_5 + 10H_2O = (VO_2)_2MgH_2(AsO_4)_2 + 9H_2O$.

Sol. in H_2O. (Friedheim.)

$2MgO$, $2V_2O_5$, $3As_2O_5+23H_2O=MgHAsO_4+2(VO_2)H_2AsO_4+9H_2O$. Sol. in H_2O. (Friedheim.)

Potassium arseniovanadate, K_2O, $2V_2O_5$, $As_2O_5+5H_2O=(VO_2)_2KAsO_4+2\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

Strontium arseniovanadate, $2SrO$, $2V_2O_5$, $3As_2O_5 + 20H_2O = SrHAsO_4 + 2(VO_2)_2H_2AsO_4+7\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

Zinc arseniovanadate, ZnO, V_2O_5, $As_2O_5+6\frac{1}{2}H_2O=Zn(VO_2)_2H_2(AsO_4)_2+5\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

$2ZnO$, $2V_2O_5$, $3As_2O_5+5H_2O$, and $+18H_2O=ZnHAsO_4+2(VO_2)_2H_2AsO_4$, and $+6\frac{1}{2}H_2O$. Sol. in H_2O. (Friedheim.)

Arseniovanadicovanadic acid.

Ammonium arseniovanadicovanadate, $5(NH_4)_2O$, $12As_2O_5$, $12VO_2$, $6V_2O_5+7H_2O$.

Sl. sol. in cold, sol. in hot H_2O, from which crystallises—

$4(NH_4)_2O$, $9As_2O_5$, $9VO_2$, $8V_2O_5 + 11H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

Arseniuretted hydrogen, AsH_3.

See **Arsenic hydride.**

Arsenosoarseniotungstic acid.

Potassium arsenosoarseniotungstate, $10K_2O, 4As_2O_5, As_2O_3, 21WO_3+26H_2O$.

Precipitate. Sol. in a large amount of hot H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

Arsenosomolybdic acid.

Ammonium arsenosomolybdate, $3(NH_4)_2O, 5As_2O_3, 12MoO_3+24H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

Barium arsenosomolybdate, $3BaO, 2As_2O_3, 8MoO_3+13H_2O$.

Very sl. sol. in H_2O. (Gibbs.)

Copper arsenosomolybdate, $2CuO, 3As_2O_3, 6MoO_3$.

Sol. in H_2O. (Gibbs.)

Manganese arsenosomolybdate, $2MnO, 3As_2O_3, 6MoO_3+6H_2O$, and $+15H_2O$.

Insol. in H_2O.

Zinc arsenosomolybdate, $2ZnO, 3As_2O_3, 6MoO_3+6H_2O$.

Sol. in H_2O. (Gibbs.)

Arsenosophosphotungstic acid.

Potassium arsenosophosphotungstate, $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3+28H_2O$.

Moderately sol. in cold, very easily in hot H_2O.

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3+55H_2O$. Sol. in hot H_2O with decomp.

Potassium sodium arsenosophosphotungstate, $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3+15H_2O$.

(Gibbs, Am. Ch. J. **7**. 313.)

Arsenosotungstic acid.

Ammonium arsenosotungstate, $7(NH_4)_2O, 2As_2O_3, 18WO_3+18H_2O$.

Sol. in H_2O.

Barium arsenosotungstate, $4BaO, As_2O_3, 9WO_3+21H_2O$.

Precipitate. Nearly insol. in H_2O.

Sodium arsenosotungstate, $9Na_2O, 8As_2O_3, 16WO_3+55H_2O$.

Very sol. in H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

Arsenyl bromide, $AsOBr$.

H_2O dissolves out As_2O_3; insol. in alcohol. (Sérullas.)

$+H_2O$. (Wallace, Phil. Mag. (4) **17**. 122.)
$As_8O_9Br_6=2AsBr_3, 3As_2O_3$.
$2AsBr_3, 11As_2O_3+12H_2O$.

Arsenyl bromide *with* **MBr.**

See **Arsenite bromide, M.**

Arsenyl chloride, $AsOCl$.

Sol. in H_2O with decomp.
$+H_2O$. (Wallace, Phil. Mag. (4) **16**. 358.)
As_3O_4Cl. (Wallace.)

Arsenyl chloride *with* **MCl.**

See **Arsenite chloride, M.**

Arsenyl potassium fluoride, $AsOF_3, KF+H_2O$.

(Marignac, A. **145**. 237.)

Arsenyl iodide, $As_8I_2O_{11}=2AsOI, 3As_2O_3+6H_2O$.

Decomp. by H_2O. (Wallace, Phil. Mag. (4) **17**. 122.)

Arsenyl iodide *with* **MI.**

See **Arsenite iodide, M.**

Arsenyl sulphoiodide, $As_{13}I_9S_6O_9$.

Scarcely attacked by cold H_2O. Boiling H_2O extracts AsI_3. Decomp. by hot HNO_3 or H_2SO_4. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **36**. 513.)

Arsine.

See **Arsenic hydride.**

Atmospheric air.

See **Air, atmospheric.**

*Sesqui*auramine, NAu_3, NH_3.

Decomp. by H_2O into NAu_3. (Raschig, A. **235**. 341.)

Auric acid, HAu_2O_4.

Sol. in HBr, or $HCl+Aq$. (Krüss, B. **19**. 2546.)

Ammonium aurate.

See **Auroamidoimide.**

Calcium aurate (?).

Insol. in H_2O; sol. in $CaCl_2+Aq$. (Fremy, A. ch. (3) **31**. 485.)

Magnesium aurate (?).

Ppt. Insol. in H_2O; sol. in $MgCl_2+Aq$. (Pelletier.)

Potassium aurate, $KAuO_2+3H_2O$.

Very sol. in H_2O, and easily decomp. (Fremy, A. ch. (3) **31**. 483.)

Sol. in alcohol; the solution in alcohol does not decomp. below 50°. (Figuier, A. ch. (3) **11**. 364.)

Potassium aurate sulphite, $KAuO_2, 2K_2SO_3+5H_2O$.

Sol. in H_2O with decomp. Nearly insol. in alkaline solutions. (Fremy, A. ch. (3) **31**. 485.)

Auriimide chloride, $Au(NH)Cl$.

(Raschig.)

Auriimide nitrate, $Au_2N_2H_2O, 2HNO_3$, or $AuN, HNO_3+\frac{1}{2}H_2O$, or $Au_2O(NH)_2, 2HNO_3$.

Not deliquescent. Decomp. by hot H_2O into $Au_2O(NH)_2$. (Schottländer, J. B. **1884**. 453.)

Auroamidoimide, $Au(NH)NH_2+3H_2O$.

(Fulminating gold.) Insol. in H_2O; not attacked by dil. acids; sol. in conc. acids, and in moderately dil. acids, when freshly precipitated. Insol. in alkalies or alcohol. Sol. in $KCN+Aq$.

Auricyanhydric acid, $HAu(CN)_4 + 1\frac{1}{2}H_2O$.

Easily sol. in H_2O, alcohol, or ether.

See also **Bromauricyanides.**
Chlorauricyanides.
Iodauricyanides.

Ammonium auricyanide, $NH_4Au(CN)_4$.

Easily sol. in H_2O or alcohol. Insol. in ether.

Cobaltous auricyanide, $Co[Au(CN)_4]_2 + 9H_2O$.

Sl. sol. in cold, easily in hot H_2O. Sl. sol. in alcohol. (Lindbom.)

Potassium auricyanide, $KAu(CN)_4 + 1\frac{1}{2}H_2O$.

Efflorescent. Sl. sol. in cold, easily in hot H_2O. Easily sol. in alcohol.

Silver auricyanide, $AgAuCN_4$.

Insol. in H_2O or HNO_3+Aq. Sol. in NH_4OH+Aq.

***Di*auro*di*amine nitrate.**

See **Auriimide nitrate.**

Aurobromhydric acid.

See **Bromauric acid.**

Aurobromic acid.

See **Bromauric acid.**

Aurochlorhydric acid.

See **Chlorauric acid.**

Aurochloric acid.

See **Chlorauric acid.**

Azoimide, HN_3.

Miscible with H_2O and alcohol. (Curtius and Radershausen, J. pr. (2) **43.** 207.)

For salts of HN_3, see azoimide of metal under metal.

Azophosphoric acid.

See ***Pyro*phosphamic acid.**

***Deut*azophosphoric acid.**

See ***Pyro*phospho*di*amic acid.**

Barium, Ba.

Decomposes H_2O at ordinary temperature.

Barium azoimide, BaN_6.

Easily sol. in H_2O. (Curtius, B. **23.** 3023.)

Barium bromide, $BaBr_2 + 2H_2O$.

100 pts. H_2O dissolve—

at 0°	20°	40°	60°	80°	100°	
98	104	114	123	135	149	pts. $BaBr_2$.

Sat. $BaBr_2$+Aq boils at 113°. (Kremers, Pogg. **99.** 43.)

Sp. gr. of $BaBr_2$+Aq at 19·5° containing:

5	10	15	20	25	30 % $BaBr_2$,
1·045	1·092	1·114	1·201	1·262	1·329

35	40	45	50	55 % $BaBr_2$.
1·405	1·485	1·580	1·685	1·800

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

Very sol. in absolute alcohol. (Hünefeld.)

100 pts. absolute methyl alcohol dissolve 50 pts. $BaBr_2$ at 22·5°.

100 pts. absolute ethyl alcohol dissolve 3 pts. $BaBr_2$ at 22·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sat. solution in 87 % alcohol contains 6 % $BaBr_2$. (Richards, Z. anorg. **3.** 455.)

100 pts. absolute methyl alcohol dissolve 45·8 pts. $BaBr_2 + 2H_2O$ at 15°.

100 pts. 93·5 % methyl alcohol dissolve 27·3 pts. $BaBr_2 + 2H_2O$ at 15°.

100 pts. 50 % methyl alcohol dissolve 4 pts. $BaBr_2 + 2H_2O$ at 15°. (de Bruyn, Z. phys. Ch. **10.** 787.)

Nearly insol. in boiling amyl alcohol, 10 ccm. dissolving only an amt. equal to 1·3 mg. BaO. (Browning, Sill. Am. J. **144.** 459.)

Barium cadmium bromide, $BaBr_2$, $CdBr_2 + 4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20.** 40.)

Barium carbide, BaC_2.

Decomp. by H_2O. (Maquenne, C. R. **144.** 360.)

Barium chloride, $BaCl_2$, and $+2H_2O$.

Permanent in dry air.

100 pts. H_2O at t° dissolve (*a*) pts. $BaCl_2$ and (*b*) pts. $BaCl_2 + 2H_2O$.

t°	*a*	*b*	t°	*a*	*b*
15·64	34·86	43·50	74·89	59·94	65·51
49·31	43·84	55·63	105·48	59·58	77·89

(Gay-Lussac, A. ch. (2) **11.** 309.)

100 pts. H_2O at t° dissolve 32·62+0·2711t pts. $BaCl_2$ (Kopp.)

100 pts. H_2O dissolve pts. $BaCl_2 + 2H_2O$ at t°.

t°	Pts. $BaCl_2 + 2H_2O$	t°	Pts. $BaCl_2 + 2H_2O$
16·25	39·66	62·50	48·0
20·00	42·22	75·00	63·0
22·50	43·7	87·00	65·0
37·50	51·0	100	72·0
50·00	65·0	..	..

(Brandes.)

Sol. in 2·67 pts. H_2O at 18·75°. (Abl.)

1 pt. $BaCl_2$ is sol. in 2·86 pts. H_2O at 15·5°, and 1·67 pts. at boiling temp. (M. R. and P.)

100 pts. H_2O at 15·5° dissolve 20 pts. $BaCl_2$, and 43 pts. at 87·7°. (Ure's Dict.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	31·1	77·5	51·9
12·2	33·9	95·65	57·7
38·4	41·2	102·5	58·9
62·75	47·7	105	59·7

(Nordenskiold, Pogg. **136.** 316.)

100 pts. H_2O dissolve pts. $BaCl_2$ at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
9	33·2	50	43·7
30	38·1	58	45·9
37	40·0	..	..

(Gerardin, A. ch. (4) **5.** 143.)

1 pt. $BaCl_2+2H_2O$ is sol. in 2·18 pts. H_2O at 21·5°, and the solution has sp. gr. 1·2878. (Schiff, A. **109.** 326.)

1 pt. anhydrous $BaCl_2$ is sol. in 2·86 pts. H_2O at 15°. (Gerlach.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	30·9	36	39·7	71	49·7
1	31·2	37	40·0	72	50·0
2	31·5	38	40·2	73	50·3
3	31·7	39	40·5	74	50·6
4	31·9	40	40·7	75	50·9
5	32·2	41	41·0	76	51·2
6	32·4	42	41·3	77	51·5
7	32·6	43	41·6	78	51·8
8	32·8	44	41·9	79	52·1
9	33·1	45	42·2	80	52·4
10	33·3	46	42·5	81	52·7
11	33·5	47	42·7	82	53·0
12	33·8	48	43·0	83	53·3
13	34·0	49	43·3	84	53·6
14	34·2	50	43·6	85	54·0
15	34·5	51	43·9	86	54·3
16	34·7	52	44·2	87	54·6
17	35·0	53	44·4	88	55·0
18	35·2	54	44·7	89	55·3
19	35·5	55	45·0	90	55·6
20	35·7	56	45·3	91	55·9
21	36·0	57	45·6	92	56·2
22	36·2	58	45·9	93	56·6
23	36·5	59	46·2	94	56·9
24	36·7	60	46·4	95	57·2
25	37·0	61	46·7	96	57·6
26	37·2	62	47·0	97	57·9
27	37·5	63	47·3	98	58·2
28	37·7	64	47·6	99	58·5
29	38·0	65	47·9	100	58·8
30	38·2	66	48·2	101	59·2
31	38·5	67	48·5	102	59·5
32	38·7	68	48·8	103	59·8
33	39·0	69	49·1	104	60·2
34	39·2	70	49·4	104·1	60·3
35	39·5	...	...	...	...

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864.** 45.)

The saturated solution contains—

60·3 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104·1°. (Mulder.)

60·1 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104·4°. (Legrand.)

61·8 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104·5°. (Griffith.)

59·58 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 105·48° (Gay-Lussac); at 106° (Kremers).

54·1 pts. $BaCl_2$ to 100 pts. H_2O, and forms crust at 104·4°; highest temperature observed, 104·9°. (Gerlach, Z. anal. **26.** 426.)

$BaCl_2+Aq$ sat. at 8° has sp. gr. 1·27. (Anthon.)

$BaCl_2+Aq$ sat. at 15° has sp. gr. 1·282. (Michel and Krafft.)

$BaCl_2+Aq$ sat. at 18·1° has sp. gr. 1·285, and contains 44·31 pts. $BaCl_2+2H_2O$ to 100 pts. H_2O. (Karsten.)

Sp. gr. of $BaCl_2+Aq$ at 19·5°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
8·88	1·0760	27·53	1·2245
18·24	1·1521	35·44	1·2837

(Kremers, Pogg. **99.** 444.)

Sp. gr. of $BaCl_2+Aq$ at 15°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
1	1·00917	14	1·13778
2	1·01834	15	1·14846
3	1·02750	16	1·15999
4	1·03667	17	1·17152
5	1·04584	18	1·18305
6	1·05569	19	1·19458
7	1·06554	20	1·20681
8	1·07538	21	1·21892
9	1·08523	22	1·23173
10	1·09508	23	1·24455
11	1·10576	24	1·25736
12	1·11643	25	1·27017
13	1·12711	...	...

(Gerlach, Z. anal. **8.** 283.)

Sp. gr. of $BaCl_2+Aq$ at 21·5°.

% $BaCl_2$, $2H_2O$	Sp. gr.	% $BaCl_2$, $2H_2O$	Sp. gr.
1	1·0073	16	1·1302
2	1·0147	17	1·1394
3	1·0222	18	1·1488
4	1·0298	19	1·1584
5	1·0374	20	1·1683
6	1·0452	21	1·1783
7	1·0530	22	1·1884
8	1·0610	23	1·1986
9	1·0692	24	1·2090
10	1·0776	25	1·2197
11	1·0861	26	1·2304
12	1·0947	27	1·2413
13	1·1034	28	1·2523
14	1·1122	29	1·2636
15	1·1211	30	1·2750

(Schiff, calculated by Gerlach, *l.c.*)

Sp. gr. of $BaCl_2+Aq$ at 18°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
5	1·0445	20	1·2047
10	1·0939	24	1·2559
15	1·1473	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

$BaCl_2+Aq$ containing 10 % $BaCl_2$ boils at 100·6°. (Gerlach.)

$BaCl_2+Aq$ containing 20 % $BaCl_2$ boils at 101·9°. (Gerlach.)

B.-pt. of $BaCl_2$+Aq containing pts. $BaCl_2$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 443); L=according to Legrand (A. ch. (2) **59.** 452).

B.-pt.	G	L
100·5°	6·4	11·0
101·0	12·7	19·6
101·5	19·0	26·2
102·0	25·3	32·5
102·5	31·6	38·6
103·0	37·7	44·5
103·5	43·7	50·3
104·0	49·5	56·0
104·4	...	60·1
104·5	55·2	...

Less sol. in H_2O containing HCl than in pure H_2O, and scarcely sol. in conc. HCl+Aq. (Berzelius.)

Solubility of $BaCl_2$ in HCl + Aq at 0°. $BaCl_2$=no. $\frac{1}{2}$ mols. (in milligrammes) dissolved in 10 ccm. of the liquid; HCl=no. mols. (in milligrammes) contained in the same quantity of liquid.

$BaCl_2$	HCl	Sum of mols.	Sp. gr.
29·45	0	29·45	1·250
27·8	1·1	28·9	1·242
26·075	2·8	28·875	1·228
23·4	5·0	28·4	1·210
14·0	14·36	28·36	1·143
10·2	18·775	28·975	1·118
6·67	22·75	29·42	1·099
2·74	32·0	34·74	1·079
0·29	50·5	50·79	1·088

(Engel, Bull. Soc. (2) **45.** 653.)

Sol. in about 8000 pts. conc. HCl+Aq.

Sol. in about 20,000 pts. conc. HCl+Aq through which HCl gas was passed.

Practically insol. in conc. HCl+Aq containing $\frac{1}{8}$ vol. ether. (Mar, Sill. Am. J. **143.** 521.)

Much less sol. in HNO_3+Aq than in H_2O, because $Ba(NO_3)_2$ is nearly insol. therein. (Wurtz.)

$BaCl_2$ is sol. in about—

4·00 pts. H_2O.

5·00 pts. NH_4OH+Aq (conc.).

5·33 pts. NH_4OH+Aq (1 vol. conc.: 3 vols. H_2O).

5·33 pts. HCl+Aq (1 vol. conc.: 4 vols. H_2O).

8·00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial acid: 1 vol. H_2O).

6·00 pts. NH_4Cl+Aq (1 pt. NH_4Cl : 10 pts. H_2O).

6·00 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH+Aq neutralised by dil. $HC_2H_3O_2$+Aq).

6·67 pts. $NaC_2H_3O_2$ + Aq (commercial $HC_2H_3O_2$ neutralised by Na_2CO_3, and dil. with 4 vols. H_2O).

6·33 pts. $Cu(C_2H_3O_2)_2$+Aq. *See* Stolba (Z. anal. **2.** 390).

5·67 pts. grape sugar (1 pt. grape sugar: 10 pts. H_2O). (Pearson, Zeit. Chem. **1869.** 662.)

Sol. in sat. $Ba(NO_3)_2$+Aq.

Very slowly sol. in sat. $NaNO_3$+Aq with separation of $Ba(NO_3)_2$.

Rapidly sol. in sat. KNO_3+Aq, forming $Ba(NO_3)_2$, which separates out. (Karsten.)

$BaCl_2$+KCl. Sol. in sat. KCl+Aq, at first without pptn. The KCl is pptd. after a time until a state of equilibrium is reached.

100 pts. H_2O at 16·6° dissolve 33·8-27·2 pts. KCl and 18·2-34·9 pts. $BaCl_2$. (Kopp, A. **34.** 267.)

$BaCl_2$+NaCl. $BaCl_2$ is sol. in NaCl+Aq at first without separation of NaCl, which, however, finally separates.

100 pts. H_2O dissolve, when both salts are in excess—

	1	2	3	4	5	6
NaCl . .	35·9	4·1	...	40·4	35·3	...
$BaCl_2$ . .	...	34·5	35·0	...	19·4	60·3
		38·6			54·7	

1, 2, and 3 are at 17°. (Kopp, A. **34.** 268.)
4, 5, and 6 are at b.-pt. (Mulder.)

Solubility of $BaCl_2$+NaCl.
100 pts. H_2O dissolve pts. $BaCl_2$ and NaCl at t°.

t°	Pts. $BaCl_2$	Pts. NaCl	t°	Pts. $BaCl_2$	Pts. NaCl
10	4·1	33·9	60	9·7	33·5
20	4·1	33·8	70	11·7	33·6
30	5·0	33·7	80	13·9	33·6
40	6·3	33·6	90	15·9	33·6
50	7·9	33·5	100	17·9	33·6

(Precht and Wittgen, B. **14.** 1667.)

Solubility in alcohol: 100 pts. alcohol of given sp. gr. dissolve pts. of the anhydrous, and crystallised salt.

Sp. gr.	Pts. $BaCl_2$	Pts. $BaCl_2+2H_2O$
0·900	1·00	1·56
0·848	0·29	0·43
0·834	0·185	0·32
0·817	0·09	0·06

(Kirwan.)

Insol. in abs. alcohol, or below 19° in alcohol of over 91%. Dil. alcohol dissolves less $BaCl_2$ than corresponds to the amount of H_2O present. (Gerardin, A. ch. (4) **5.** 142.)

Solubility in 100 pts. alcohol at t°. D=sp. gr. of alcohol; s=solubility.

D=0·9904		D=0·9848		D=0·9793		D=0·9726	
t°	s	t°	s	t°	s	t°	s
14	29·1	14	25·0	11	19·6	15	15·6
25	32·0	32	29·1	15	20·4	23	17·0
32	33·5	39	30·9	20	21·7	33	19·1
47	37·4	50	33·2	35	24·6	50	22·0
60	39·8	63	37·6	45	26·8	..	..

Solubility in 100 pts. alcohol, etc.—*Continued.*

D=0·9573		D=0·9390		D=0·8967		D=0·8429	
t°	s	t°	s	t°	s	t°	s
13	10	12	6·5	12	0·1	12	0·00
24	11·4	23	7·2	30	4·3	19	0·00
34	12·9	31	8·3	47	4·9	25	0·04
39	13·8	37	9·0	..	..	50	0·28
50	15·2	47	10·1	..	..	67	0·377

(Gerardin, A. ch. (4) **5.** 142.)

Solubility in dil. alcohol of *x* % by weight at 15°.

% alcohol	0	10	20	30	40	60	80
Pts. $BaCl_2,2H_2O$	30·25	23·7	18·0	12·8	9·3	3·4	0·5

(Schiff, A. **118.** 365.)

Sol. in 6885-8108 pts. 99·3 % alcohol at 14·5°, and in 1857 pts. at ebullition. (Fresenius.)

100 pts. absolute methyl alcohol dissolve 2·18 pts. $BaCl_2$ at 15·5°, and 7·3 pts. $BaCl_2$, $2H_2O$ at 6°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Absolutely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. **144.** 459.)

Absolutely insol. in acetic ether. (Cann, C. R. **102.** 363.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Barium cadmium chloride, $BaCl_2$, $2CdCl_2+5H_2O$.

Quite difficultly sol. in H_2O. (v. Hauer.)

$BaCl_2$, $CdCl_2+4H_2O$. Easily sol. in H_2O. (v. Hauer.)

Barium mercuric chloride, basic, $BaCl_2$, $HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium mercuric chloride, $BaCl_2$, $2HgCl_2+2H_2O$.

Efflorescent in dry air; sol. in H_2O. (v. Bonsdorff, Pogg. **17.** 130.)

Barium rhodium chloride, $3BaCl_2$, Rh_2Cl_6.

See **Chlororhodite, barium.**

Barium stannous chloride, $BaCl_2$, $SnCl_2+4H_2O$.

Sol. in H_2O. (Poggiale, C. R. **20.** 1183.)

Barium stannic chloride.

See **Chlorostannate, barium.**

Barium zinc chloride, $BaCl_2$, $ZnCl_2+4H_2O$.

Deliquescent, and sol. in H_2O. (Warner, C. N. **27.** 271.)

Barium chloride fluoride, BaClF.

Difficultly sol. in H_2O, but much more sol. than BaF_2. Decomp. by H_2O, so that when washed on filter, the filtrate contains more $BaCl_2$ than BaF_2. (Berzelius, Pogg. **1.** 19.)

Barium chloride hydroxylamine, $BaCl_2$, $2NH_2OH$.

Very sol. in H_2O. (Crismer, Bull. Soc. (3) **3.** 118.)

Barium chloride sulphuric anhydride, $BaCl_2$, $2SO_3$.

Decomp. by H_2O. (Schultz-Sellack, B. **4.** 113.)

Barium fluoride, BaF_2.

Scarcely sol. in H_2O (Berzelius); less sol. in H_2O than CaF_2.

Easily sol. in HCl, HNO_3, or HF + Aq. (Gay-Lussac and Thénard.)

Sol. in an aqueous solution of sodium citrate. (Spiller.)

Barium stannic fluoride.

See **Fluostannate, barium.**

Barium tellurium fluoride, BaF_2, $2TeF_4$.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Barium titanyl fluoride, $TiOF_2$, BaF_2.

See **Fluoxypertitanate** *and* **fluoxytitanate, barium.**

Barium uranyl fluoride.

See **Fluoxyuranate, barium.**

Barium zirconium fluoride, $3BaF_2$, $2ZrF_4+2H_2O$.

Insoluble precipitate. (Marignac.)

See also **Fluozirconate, barium.**

Barium hydride, BaH.

Decomp. by H_2O or HCl + Aq. (Winkler, B. **24.** 1979.)

Barium hydrosulphide, BaS_2H_2.

Easily sol. in H_2O. Insol. in alcohol.

$+4H_2O$. Sol. in H_2O, and the solution dissolves S. (Veley, Chem. Soc. **49.** 369.)

Barium hydroxide, BaO_2H_2.

100 pts. cold H_2O dissolve 5 pts. BaO_2H_2.
" boiling " 50 "
(Davy.)

100 pts. H_2O at 20° dissolve 3·45 pts. BaO.
(Bineau, C. R. **41.** 509.)

100 pts. H_2O at 13° dissolve 2·86 pts. BaO.
" " 47° " 13·3 "
" " 70° " 17·9 "
(Osann.)

Sp. gr. of BaO_2H_2+Aq.

% BaO	Sp. gr.	% BaO	Sp. gr.
30	1·6	1·8	1·02
19	1·3	0·9	1·01
2·6	1·03	..	..

(Dalton.)

100 pts. H_2O dissolve pts. BaO at t°.

t°	Pts. BaO	t°	Pts. BaO	t°	Pts. BaO
0	1·5	30	5·0	60	18·76
5	1·75	35	6·17	65	24·67
10	2·22	40	7·36	70	31·9
15	2·89	45	9·12	75	56·85
20	3·48	50	11·75	80	90·77
25	4·19	55	14·71	...	...

(Rosenthiel and Rühlmann, J. B. **1870.** 314.)

More sol. in NaCl + Aq, KNO_3 + Aq, or $NaNO_3$ + Aq than in H_2O. (Karsten.)

Not precipitated by alcohol.

Sol. with combination in absolute alcohol and anhydrous methyl alcohol. Insol. in ether.

BaO_2H_2 is sol. in an aqueous solution of cane sugar (Hunton, Phil. Mag. (3) **11.** 156); also in an aqueous sol. of mannite (Favre, A. ch. (3) **11.** 76); sorbine (Pelouze); hot solution of quercite, separating on cooling (Dessaignes).

$+8H_2O$. Sol. in 20 pts. cold, and 3 pts. boiling H_2O (Graham); 17·5 pts. H_2O at 15·5°, and in all proportions of hot H_2O. (Hope.) Sol. in 19 pts. H_2O at 15°, and 2 pts. at 100°. (Wittstein.)

Readily sol. in cold NH_4Cl+Aq; sl. sol. in Na, and K acid silicate + Aq.

Melts in its crystal H_2O below 100°.

$+H_2O$. Sol. in methyl alcohol. (Forcrand, C. R. **103.** 59.)

Barium iodide, BaI_2.

Not deliquescent. Very sol. in H_2O and alcohol. 100 pts. of anhydrous salt dissolve:

at 0°	19·5°	30°	40°	60°	90°	106°
in 59	48	44	43	41	37	35 pts. H_2O.

(Kremers, Pogg. **103.** 66.)

Sp. gr. of BaI_2+Aq containing:

5	10	15	20	25	30 % BaI_2,
1·045	1·091	1·143	1·201	1·265	1·333

35	40	45	50	55	60 % BaI_2.
1·412	1·495	1·596	1·704	1·825	1·970

(Kremers, Pogg. **111.** 63, calculated by Gerlach, Z. anal. **8.** 279.)

Cryst. with $2H_2O$; also $7H_2O$. (Thomson, B. **10.** 1343.)

Easily sol. in alcohol. (Henry.)

Barium iodide, basic, $Ba(OH)I+9H_2O$.

See **Barium oxyiodide.**

Barium bismuth iodide, $BaI_2, 2BiI_3+18H_2O$.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Barium cadmium iodide, BaI_2, CdI_2+5H_2O.

Deliquescent. (Croft.)

Barium mercuric iodide, $BaI_2, 2HgI_2$.

Decomp. by much H_2O. (Boullay.)

BaI_2, HgI_2. Sol. in H_2O. (Boullay.)

Sp. gr. of sat. solution = 3·575-3·588. (Rohrbach, W. Ann. **20.** 169.)

Barium stannous iodide.

Very sol. in H_2O. (Boullay.)

Barium zinc iodide, $BaI_2, 2ZnI_2$.

Deliquescent, and sol. in H_2O. (Rammelsberg.)

Barium nitride, Ba_3N_2.

Decomp. H_2O violently, not alcohol. (Maquenne, A. ch. (6) **29.** 219.)

Barium oxide, BaO.

Sol. in H_2O with evolution of heat.

Easily sol. in dil. HNO_3, or $HCl+Aq$.

Sol. with combination in absolute alcohol and anhydrous wood-spirit. Insol. in ether.

Easily sol. in absolute methyl alcohol.

1 l. absolute ethyl alcohol sat. with BaO at 9° contains 213·8 g. BaO. (Berthelot, Bull. Soc. **8.** 389.)

See also **Barium hydroxide.**

Barium *per*oxide, BaO_2.

Insol. in H_2O; decomp. by boiling H_2O.

Sol. in acids with formation of hydrogen dioxide.

Forms hydrate with $8H_2O$; also $10H_2O$ (Berthelot, A. ch. (5) **21.** 157); also a compound BaO_2, H_2O_2, which is very unstable, sl. sol. in cold H_2O, and insol. in alcohol or ether. (Schöne, A. **192.** 257.)

Barium oxybromide, $Ba(OH)Br+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **27.** 132.)

Barium oxychloride, $Ba(OH)Cl+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **26.** 388, 474.)

Barium mercury oxychloride, $BaCl_2, HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium oxyiodide, $Ba(OH)I+9H_2O$.

Decomp. by H_2O and alcohol. (Beckmann, B. **14.** 2154.)

Barium oxysulphides, $Ba_7O_4S_3+58H_2O$, $Ba_2OS+10H_2O$, $Ba_4S_3O+28H_2O$.

Very unstable; decomp. by recrystallisation into BaS_2H_2 and BaO_2H_2.

Barium phosphide, BaP_2.

Decomp. by H_2O. (Dumas, A. ch. **32.** 364.)

Barium selenide, BaSe.

Sol. in H_2O with decomp.

Sl. sol. in H_2O. (Favre, C. R. **102.** 1469.)

Barium sulphide, BaS.

Sol. in H_2O with decomp.

$+6H_2O$. Slowly sol. in boiling H_2O, with decomp; insol. in, but decomp. by boiling alcohol. (Schöne.)

Barium sulphide, $Ba_4S_7+25H_2O$ (?).

Sol. in H_2O. (Schöne, Pogg. **112.** 215.)

Barium *tri*sulphide, BaS_3.

Sol. in large amount of boiling H_2O. (Schöne, Pogg. **112.** 215.)

Barium *tetra*sulphide, BaS_4+H_2O.

Easily sol. in H_2O, especially if hot; sol. in 2·42 pts. H_2O at 15°; insol. in CS_2 or alcohol. (Schöne, Pogg. **112.** 224.)

$+2H_2O$. (Veley, Chem. Soc. **49.** 369.)

Barium *penta*sulphide, BaS_5.

Known only in solution.

Barium mercuric sulphide, $BaS, HgS+5H_2O$.

Sol. in H_2O. (Wagner, J. pr. **98.** 23.)

Barium stannic sulphide.

See **Sulphostannate, barium.**

Barium uranyl sulphide, $6BaS, UO_2S+xH_2O$ (?).

Decomp. by $HCl+Aq$. (Remelè, Pogg. **124.** 159.)

Baryta.

See **Barium oxide**, BaO.

Beryllium, Be.

For beryllium and its salts, see **Glucinum** and the corresponding salts.

Bismuth, Bi.

Not attacked by H_2O. Very slowly attacked by HCl+Aq (Troost). Very sl. sol. in conc. HCl+Aq (Schützenberger, Willm). Not attacked by dil. HCl+Aq (Naquet and Hanriot). Very slowly attacked by cold HCl+Aq (Godeffroy). According to very careful experiments pure Bi is absolutely unattacked by hot or cold, dil. or conc. HCl+Aq except in presence of oxygen. (Ditte and Metzner, A. ch. (6) **29.** 397.)

Not attacked by dil. H_2SO_4+Aq. Decomp. by hot conc. H_2SO_4. Easily sol. in dil. or conc. HNO_3+Aq, or aqua regia.

Not attacked by pure HNO_3+Aq of 1·52 to 1·42 sp. gr. at 20°; violently attacked by a more dil. acid, but the acid becomes concentrated thereby. Conc. HNO_3+Aq attacks only by heating or adding NO_2. (Millon, A. ch. (3) **6.** 95.)

Bismuth arsenide, Bi_3As_4.

(Descamp, C. R. **86.** 1065.)

Bismuth *di***bromide,** Bi_2Br_4.

Not known in a pure state. (Weber, Pogg. **107.** 599.)

Bismuth *tri***bromide,** $BiBr_3$.

Very deliquescent. Decomp. by H_2O. Sol. in alcohol or ether.

Bismuth bromide ammonia, $BiBr_3, 3NH_3$.

Sol. in HCl+Aq.

$BiBr_3, 2NH_3$ (?).

$2BiBr_3, 5NH_3$. Not deliquescent; not decomp. by H_2O; easily sol. in dil. acids. (Muir, Chem. Soc. **29.** 144.)

Bismuth bromide potassium chloride, $K_2BiCl_3Br_2+1\frac{1}{2}H_2O$.

Decomp. by H_2O. (Atkinson, Chem. Soc. **43.** 289.)

Bismuth *di***chloride,** Bi_2Cl_4.

Very deliquescent. Decomp. by H_2O, dil. acids, or conc. NH_4Cl+Aq. (Weber, Pogg. **107.** 596.)

Bismuth *tri***chloride,** $BiCl_3$.

Deliquescent. Decomp. by H_2O. Sol. in dil. HCl+Aq, and alcohol. Not decomp. by H_2O in presence of citrates. (Spiller.)

Bismuth chloride, Bi_3Cl_8 (?).

Decomp. by H_2O. (Dehérain, C. R. **54.** 724.)

Bismuth hydrogen chloride, $2BiCl_3, HCl+3H_2O$.

Not deliquescent. Decomp. by H_2O. (Engel, C. R. **106.** 1797.)

$BiCl_3, 2HCl$. (Jacquelain, A. ch. (2) **62.** 363.)

Bismuth cæsium chloride, $BiCl_3, 3CsCl$.

Decomp. by H_2O. Sl. sol. in cold dil. HCl+Aq, but easily sol. on warming. (Brigham, Am. Ch. J. **14.** 181.)

$2BiCl_3, 3CsCl$. As above. (Brigham.)

$BiCl_3, 6CsCl$. Easily sol. in H_2O and dil. HCl+Aq. (Godeffroy, B. **8.** 9.)

Does not exist. (Brigham.)

Bismuth nitrosyl chloride, $BiCl_3, NOCl$.

Very deliquescent. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 662.)

Bismuth potassium chloride, $BiCl_3, KCl+H_2O$.

Decomp. by H_2O. Cannot be recryst. except from conc. $BiCl_3$+HCl. Decomp. by HCl+Aq into $BiCl_3, 2KCl+2H_2O$. (Brigham, Am. Ch. J. **14.** 167.)

$BiCl_3, 2KCl$. Decomp. by H_2O. (Arppe, Pogg. **64.** 37.)

$+2H_2O$. Decomp. by H_2O. (Jacquelain, J. pr. **14.** 1.)

Sol. in moderately conc. HCl+Aq.

$BiCl_3, 3KCl$. Decomp. by H_2O. (Arppe.)

Does not exist. (Brigham.)

Bismuth rubidium chloride, $BiCl_3, RbCl+H_2O$.

Decomp. by H_2O; sol. in dil. HCl+Aq, from which $BiCl_3, 3RbCl$ crystallises. (Brigham, Am. Ch. J. **14.** 174.)

$BiCl_3, 3RbCl$. Decomp. by H_2O; sol. in dil. HCl+Aq without decomp. (Brigham.)

$BiCl_3, 6RbCl$. Decomp. by H_2O; sol. in HCl+Aq (Godeffroy, B. **8.** 9); does not exist. (Brigham.)

$10BiCl_3, 23RbCl$ (?). As above. (Brigham.)

Bismuth sodium chloride, $BiCl_3, 2NaCl+H_2O$.

$+3H_2O$. Decomp. by H_2O. (Arppe, Pogg. **64.** 237.)

$BiCl_3, 3NaCl$.

Bismuth chloride ammonia, $2BiCl_3, NH_3$.

Stable. (Dehérain, C. R. **54.** 724.)

$BiCl_3, 2NH_3$. (D.)

$BiCl_3, 3NH_3$. (D.)

Bismuth chloride selenide.

See **Bismuth selenochloride.**

Bismuth *tri***fluoride,** BiF_3.

Insol. in H_2O or alcohol. (Gott and Muir, Chem. Soc. **53.** 138.)

Bismuth hydrogen fluoride, $BiF_3, 3HF$.

Deliquescent. Decomp. by boiling H_2O. (Muir, Chem. Soc. **39.** 21.)

Bismuthous hydroxide, $Bi(OH)_3$.

Sol. in strong acids. Insol. in solutions of alkalies, alkali carbonates, $(NH_4)_2CO_3$, or NH_4NO_3; or of amyl amine (Wurtz). When recently pptd. is sol. in NH_4Cl+Aq, but insol. in NH_4NO_3+Aq (Brett, **1837**). Not pptd. in presence of Na citrates (Spiller).

$Bi_2O_3, 2H_2O$.

Bi_2O_3, H_2O. (Muir, Chem. Soc. **32.** 131.)

Bismuth *tetra***hydroxide,** Bi_2O_4, H_2O.

$Bi_2O_4, 2H_2O$. (Wernicke, Pogg. **141.** 109.)

Bismuthic hydroxide (**Bismuthic acid**), Bi_2O_5, H_2O.

Insol. in H_2O; easily decomp. by acids. (Fremy, A. ch. (3) **12.** 495.) Decomp. by H_2SO_4; not attacked by SO_2+Aq; neither dissolved nor decomp. by dil. HNO_3+Aq, but slowly converted into an allotropic modification (?). Partially decomp. by conc. HNO_3. Slowly but wholly dissolved by hot conc. HNO_3. Sl. sol. in conc. KOH+Aq. (Arppe.)

Sol. in about 100 pts. boiling KOH+Aq, so conc. that it solidifies on removing the lamp. (Muir, Chem. Soc. **51.** 77.)

Bi_2O_5, $2H_2O$. (Bödeker, A. **123.** 61.)

Does not exist. (Hoffmann and Geuther.)

Bismuth iodide, BiI_3.

Not attacked by cold H_2O, but by boiling, BiOI is formed. 100 pts. absolute alcohol dissolve 3½ pts. salt at 20°. (Gott and Muir, Chem. Soc. **57.** 138.)

Sol. in HNO_3, and HI+Aq, from which it is repptd. by H_2O or alcohol. Sol. in KI+Aq or KOH+Aq. (Rammelsberg.)

100 pts. methylene iodide dissolve 0·15 pt. BiI_3 at 12°, and very little more at higher temperatures. (Retgers, Z. anorg. **3.** 343.)

Bismuth hydrogen iodide, BiI_3, $HI+4H_2O$.

(Arppe, Pogg. **44.** 248.)

Bismuth calcium iodide, $2BiI_3$, CaI_2+18H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth magnesium iodide, $2BiI_3$, MgI_2+12H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth potassium iodide, BiI_3, 4KI.

Ppt. (Arppe, Pogg. **44.** 237.)

BiI_3, 3KI. (Astre, C. R. **110.** 1137.)

BiI_3, 2KI. Sol. in acetic ether. (Astre.)

$+4H_2O$. Sol. in small amt. H_2O without pptn., but decomp. by much H_2O.

BiI_3, 2KI, HI. (Arppe.)

$2BiI_3$, $3KI+2H_2O$. (Astre.)

BiI_3, $KI+H_2O$. Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, KI. Sol. in acetic ether. (Astre.)

Bismuth sodium iodide, BiI_3, $NaI+H_2O$.

Deliquescent; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, $3NaI+12H_2O$. As above. (Linau, Pogg. **111.** 240.)

Bismuth zinc iodide, $2BiI_3$, ZnI_2+12H_2O.

Very deliquescent. (Linau, Pogg. **111.** 240.)

Bismuth iodide ammonia, BiI_3, $3NH_3$.

Decomp. by H_2O. (Rammelsberg.)

Bismuth iodide zinc bromide.

Sol. in H_2O. (Linau, Pogg. **111.** 240.)

Bismuth *di*oxide, Bi_2O_2.

Sol. in conc. HNO_3+Aq. Decomp. by strong acids, and boiling KOH+Aq.

Bismuth *tri*oxide, Bi_2O_3.

Insol. in H_2O. Sol. in conc. acids.

Min. *Bismite.* Easily sol. in HNO_3+Aq.

See also **Bismuthous hydroxide.**

Bismuth *tetr*oxide, Bi_2O_4.

Sol. in conc. HCl+Aq, with evolution of Cl; in oxygen acids with evolution of O. Less easily sol. in conc. H_2SO_4 than in HNO_3, or HCl+Aq.

Bismuth oxide, Bi_4O_9 (?).

(Hoffmann and Geuther.)

Bismuth *pent*oxide, Bi_2O_5.

Sol. in dil. acids. Combines with H_2O to form bismuthic hydroxide, which see. (Hasebroek, B. **20.** 213.)

Bismuth oxybromide, etc.

See **Bismuthyl bromide**, etc.

Bismuth phosphide, BiP.

(Cavazzi.)

Bismuth *tri*selenide, Bi_2Se_3.

Insol. in H_2O, alkalies, or alkali sulphides +Aq; sl. attacked by HCl+Aq; oxidised by HNO_3+Aq. (Schneider, Pogg. **94.** 628.)

Min. *Frenzelite.*

Bismuth selenochloride, BiSeCl.

Not attacked by H_2O; very sl. sol. in HCl+Aq; easily and completely sol. with decomp. in HNO_3+Aq. (Schneider.)

Bismuth *di*sulphide, $Bi_2S_2+2H_2O$ (?).

Insol. in H_2O. Decomp. by HCl+Aq.

Bismuth *tri*sulphide, Bi_2S_3.

Insol. in H_2O. Easily sol. in moderately dil. HNO_3+Aq, and conc. HCl+Aq, with separation of S. Insol. in alkalies, alkali sulphides, $Na_2S_2O_3$, or KCN+Aq; insol. in NH_4Cl, or NH_4NO_3+Aq (Brett). Insol. in potassium thiocarbonate +Aq. (Rosenbladt, Z. anal. **26.** 15.)

Min. *Bismuthinite.* Easily sol. in HNO_3+Aq.

Bismuth cuprous sulphide, Bi_2S_3, Cu_2S.

Insol. in H_2O. Sol. with decomp. in HNO_3+Aq. (Schneider, J. pr. (2) **40.** 564.)

Min. *Emplectonite.*

Bismuth potassium sulphide, Bi_2S_3, K_2S.

(Schneider, Pogg. **136.** 460.)

Bismuth sodium sulphide, Bi_2S_3, Na_2S.

(Schneider.)

Bismuth sulphide telluride, Bi_2S_3, $2Bi_2Te_3$.

Min. *Tetradymite.* Sol. in HNO_3 with separation of S.

Bi_2S_2, $2Bi_2Te$.

Min. *Joseite.* As above.

Bismuth sulphochloride, BiSCl.

Insol. in H_2O or dil. HCl+Aq. Sol. in conc. HCl, or HNO_3+Aq. Decomp. by alkalies +Aq. (Schneider, Pogg. **93.** 464.)

Bismuth sulphoiodide, BiSI.

Not attacked by boiling H_2O, and dil. acids. Decomp. by hot conc. HCl+Aq, and HNO_3+Aq. KOH+Aq dissolves out I_2. (Schneider, Pogg. **110.** 114.)

Bismuth telluride, Bi_2Te_3.

Min. *Tetradymite.* Sol. in HNO_3+Aq.

See also **Bismuth sulphide telluride.**

Bismuthic acid, $HBiO_3$.

See **Bismuthic hydroxide.**

Potassium bismuthate, $KBiO_3$.

Sol. in H_2O. (Arppe.)

$KH(BiO_3)_2$. Insol. in H_2O.

Not decomp. by boiling H_2O. (André, C. R. **113**. 860.)

No salts of $HBiO_3$ can exist. (Muir and Carnegie, Chem. Soc. **51**. 77.)

Bismuthyl bromide, BiOBr.

Insol. in H_2O; sol. in moderately conc. HBr+Aq.

$Bi_8O_9Br_6$. Insol. in H_2O; easily sol. in conc. HCl, or HNO_3+Aq; less sol. in dil. HNO_3+Aq.

$Bi_{11}O_{13}Br_7$. As the preceding comp. (Muir.)

Bismuthyl chloride, BiOCl.

Insol. in H_2O or dil. acids. Sol. in conc. HCl, or HNO_3+Aq.

$+H_2O$. (Heintz, Pogg. **63**. 55.)

$+3H_2O$. (Phillips, Br. Arch. (1) **39**. 41.)

$Bi_7O_9Cl_3$. (Arppe.)

BiO_2Cl_3. Insol. in H_2O; sol. in hot HCl, or HNO_3+Aq. (Muir.)

Bismuthyl fluoride, BiOF.

Insol. in H_2O; sol. in HCl, HBr, or HI+Aq. (Gott and Muir, Chem. Soc. **33**. 139.)

BiOF, 2HF. Insol. in H_2O.

Bismuthyl iodide, BiOI.

Not decomp. by H_2O or alkaline solutions. Sol. in HCl+Aq. Decomp. by HNO_3+Aq. (Schneider, J. pr. **79**. 424.)

Insol. in KCl, or KI+Aq.

BiI_3, $5Bi_2O_3$. Ppt. Sl. sol. in $HC_2H_3O_2$+Aq. Not decomp. by H_2O. (Fletcher and Cooper, Pharm. J. (3) **13**. 254.)

$4BiI_3$, $5Bi_2O_3$. Easily sol. in HCl+Aq. Decomp. by HNO_3+Aq. Sl. attacked by H_2SO_4; somewhat sol. in $H_2C_4H_4O_6$, and $KHC_4H_4O_6$+Aq.

Sol. in $(NH_4)_2S$, and KOH+Aq. (Storer's Dict.)

Bismuthyl sulphide, Bi_6O_3S.

(Hermann, J. pr. **75**. 452.)

Bi_2O_2S. Insol. in H_2O. (Scherpenberg, C. C. **1889, 2**. 641.)

Bi_4O_3S.

Min. *Karelinite.*

Boracic acid.

See **Boric acid.**

Borax.

See ***Tetra*****borate, sodium.**

Boric acid, anhydrous, B_2O_3.

See **Boron *tri*oxide.**

Meta**boric acid,** HBO_2.

Sol. in H_2O.

Ortho**boric acid,** H_3BO_3.

Sol. in	33	pts. H_2O	at	10°.
,,	25	,,	,,	20°.
,,	3	,,	,,	100°.

(Berzelius.)

Sol. in 20 pts. H_2O at 18·75°. (Abl.)
100 pts. H_2O at 100° dissolve 2 pts. (Ure's Dict.)

1 pt. crystallised acid dissolves in—

25·66	pts. H_2O	at	19°.
14·88	,,	,,	25°.
12·66	,,	,,	37·5°.
10·16	,,	,,	50°.
6·12	,,	,,	62·5°.
4·73	,,	,,	75°.
3·55	,,	,,	87·5°.
2·97	,,	,,	100°.

Or, 100 pts. H_2O dissolve at—

19°	3·9	pts.	H_3BO_3.
25°	6·8	,,	,,
37·5°	7·8	,,	,,
50°	9·8	,,	,,
62·5°	16·0	,,	,,
75°	21·0	,,	,,
87·5°	28·0	,,	,,
100°	34·0	,,	,,

Or, sat. aqueous solution contains at—

19°	3·75	%	H_3BO_3.
25°	6·27	,,	,,
37·5°	7·32	,,	,,
50°	8·96	,,	,,
62·5°	14·04	,,	,,
75°	17·44	,,	,,
87·5°	21·95	,,	,,
100°	25·17	,,	,,

(Brandes and Firnhaber, Arch. Pharm. **7**. 50.)

1 litre H_2O dissolves at—

0°	19·47	g.	H_3BO_3.
12°	29·20	,,	,,
20°	39·92	,,	,,
40°	69·91	,,	,,
62°	114·16	,,	,,
80°	168·15	,,	,,
102°	291·16	,,	,,

(Ditte, C. R. **85**. 1069.)

Sp. gr. of H_3BO_3+Aq at 15°.

% H_3BO_3	Sp. gr.	% H_3BO_3	Sp. gr.
1	1·0034	4	1·0147
2	1·0069	Sat. sol.	1·015
3	1·0106	...	...

(Gerlach, Z. anal. **28**. 473.)

Sp. gr. of H_3BO_3+Aq sat. at 8°=1·014. (Anthon, A. **24**. 241.)

Sp. gr. of H_3BO_3+Aq sat. at 15°=1·0248. (Stolba, J. pr. **90**. 457.)

Volatile with steam.

More sol. in dil. HCl+Aq than in H_2O. Sol. in warm conc. H_2SO_4, HCl, or HNO_3+Aq. Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff.) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

100 pts. glycerine (sp. gr. 1·26 at 15·5°) dissolve pts. H_3BO_3 at t°.

t°	Pts. H_3BO_3	t°	Pts. H_3BO_3	t°	Pts. H_3BO_3
0	20	40	38	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56	...	...

(Hooper, Ph. J. Trans. (3) **13**. 258.)

Sol. in 10 pts. glycerine. (Hager.)
Sol. in 250 pts. benzene. (Hager.)
Solubility in H_2O is increased by presence of tartaric acid or tartrates.
Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6**. 184.)
Min. *Sassolite.*

***Pyro*boric (*tetra*boric) acid,** $H_2B_4O_7$.

Sol. in H_2O.

Sp. gr. of solutions of boric acid, calculated as $H_2B_4O_7$, containing—

6·3	1·27	1·91	2·54	% $H_2B_4O_7$
1·0034	1·0069	1·0106	1·0147	sp. gr.

Sat. solution at 15° has sp. gr. 1·015. (Gerlach, Z. anal. **28**. 473.)

Borates.

No borate is quite insol. in H_2O; the alkali borates are very sol. The less sol. borates are easily decomp. by H_2O; the easily sol. salts are also decomp., but less quickly. The less sol. borates are easily sol. in H_3BO_3, HNO_3, etc. They are more sol. in H_2O containing tartaric acid or potassium tartrate than in pure H_2O. (Souberain.) The normal borates of the alkaline-earths are sol. to no inconsiderable extent in H_2O, and more readily in hot, than in cold H_2O. (Berzelius, Pogg. **34**. 568.)
All borates are insol., or sl. sol. in alcohol.

Aluminum borate, $2Al_2O_3$, B_2O_3.

Min. *Jeremcicwite.*
$+3H_2O$. Ppt. (Rose, Pogg. **91**. 452.)
$3Al_2O_3$, B_2O_3. *Crystallised.* Insol. in HNO_3+Aq. (Ebelmen, A. ch. (3) **33**. 62.)
$3Al_2O_3$, $2B_2O_3+7H_2O$. Ppt. (Rose, *l.c.*)

Ammonium *tetra*borate, $(NH_4)_2B_4O_7+4H_2O$, or perhaps $NH_4H(BO_2)_2+1\frac{1}{2}H_2O$.

Sol. in 12 pts. cold H_2O; decomp. by heat. (Rammelsberg, Pogg. **90**. 21.)
$+H_2O$. (Arfvedson.)

Ammonium *octo*borate, $(NH_4)_2B_8O_{13}+6H_2O$.

Sol. in 8 pts. cold, decomp. by boiling H_2O. (Rammelsberg, Pogg. **90**. 21.)
$+4H_2O$.
Min. *Lardellerite.* Sol. in H_2O with decomp.

Ammonium *deka*borate, $(NH_4)_2B_{10}O_{16}+6H_2O$.

Permanent. Sol. in H_2O. (Rammelsberg.)
$+8H_2O$. (Atterberg, Bull. Soc. (2) **22**. 350.)

Ammonium *dodeka*borate, $(NH_4)_2B_{12}O_{19}+9H_2O$.

Sol. in hot H_2O. (Bechi, Sill. Am. J. (2) **17**. 129.)

Ammonium calcium borate, $(NH_4)_8CaB_4O_{11}=CaB_4O_7+4(NH_4)_2O$.

(Ditte, C. R. **96**. 1663.)

Ammonium magnesium borate.

Sol. in H_2O, decomp. by boiling. (Rammelsberg, Pogg. **49**. 451.)

Ammonium zinc borate, $4(NH_4)_2B_4O_7$, $Zn(BO_2)_2+5H_2O$.

(Ditte, C. R. **96**. 1663.)

Barium borate, $Ba(BO_2)_2$.

Ppt.
$+H_2O$.
$+2H_2O$. (Atterberg.)
$+4H_2O$. (Benedikt, B. **7**. 703.)

Sol. in 3,300 pts. 45 % alcohol.
,, 7,800 ,, 50 ,,
,, 25,000 ,, 60 ,,
,, 55,000 ,, 75 ,,
(Berg, Z. anal. **16**. 25.)

$+10H_2O$. Sl. sol. in cold, more readily in hot H_2O, especially in presence of ammonium salts. (Berzelius, Pogg. **34**. 568.) Sol. in sodium citrate + Aq. (Spiller.) Insol. in wood spirit. (Ebelmen.)
BaB_4O_7. Slowly sol. in warm dilute HNO_3+Aq. (Ditte, C. R. **77**. 892.)
$+5H_2O$. Sol. in 100 pts. cold, and more freely in hot H_2O. When freshly pptd. sol. in cold NH_4Cl+Aq (Wackenroder, A. **41**. 315); NH_4NO_3+Aq (Brett, Phil. Mag. (3) **10**. 96); and $BaCl_2+Aq$ (Rose).
$BaB_6O_{10}+13H_2O$. (Laurent, A. ch. (2) **67**. 215.)
$Ba_3(BO_3)_2$.
$Ba_2B_2O_5$. (Bloxam, Chem. Soc. **14**. 143.)
$5BaO$, $2B_2O_3$.
$Ba_3B_{10}O_{18}+6H_2O$. Sol. in 100 pts. cold H_2O. Easily sol. in ammonium nitrate, or chloride, or barium chloride + Aq. (Rose, Pogg. **87**. 1.)
$Ba_2B_6O_{11}$. Easily sol. in warm dilute acids.
$+6H_2O$.
$+7H_2O$.
$+15H_2O$. (Laurent, A. ch. (2) **67**. 215.)

Bismuth borate (?).

Insol. in H_2O. (Storer's Dict.)

Cæsium borate, $Cs_2B_6O_{10}$.

Very sol in H_2O, less in alcohol. (Reischle, Z. anorg. **4**. 116.)

Cadmium borate, $3CdO$, $2B_2O_3+3H_2O$.

Ppt. Sl. sol. in H_2O. (Rose, Pogg. **88**. 299.)
$Cd(BO_2)_2$. Difficultly sol. in H_2O (Stromeyer); insol. in H_2O, sol. in $HCl+Aq$ (Odling); easily sol. in warm NH_4Cl+Aq (Rose).

Calcium borate, basic, $3CaB_4O_7$, $CaO_2H_2+9H_2O$.

Sl. sol. in H_2O.
$5CaB_4O_7$, $2CaO_2H_2+15H_2O$. Ppt.

Calcium borate, $Ca(BO_2)_2+2H_2O$.

Sl. sol. in H_2O; insol. in alkali chlorides, or boiling conc. acetic acid + Aq; sol. in cold or hot solutions of ammonium salts, especially ammonium nitrate, in $CaCl_2$+Aq, and also easily sol. in dilute mineral acids at 50°. (Ditte, C. R. **80.** 490, 561.)

+$7H_2O$. Sol. in H_2O without decomp.; 1 l. solution contains 2 g. salt. (Ditte, C. R. **96.** 1663.)

CaB_4O_7. Decomp. by H_2O. (Blount, C. N. **54.** 208.)

+$3H_2O$. (Ditte, C. R. **96.** 1663.)

+$4H_2O$. Min. *Bechilite.*

+$6H_2O$. Min. *Borocalcite.* Sol. in acids.

$Ca_2B_6O_{11}$. (Ditte, C. R. **77.** 785.)

+$3H_2O$. Min. *Pandermite, Priceite.*

+$6H_2O$.

$CaB_8O_{13}+12H_2O$. (Ditte, C. R. **96.** 1663.)

$Ca_3B_{10}O_{18}$. Precipitate.

Calcium ferrous borate silicate, $Ca_2FeB_2Si_2O_{10}$.

Min. *Homilite.* Easily sol. in HCl+Aq.

Calcium magnesium borate, CaO, MgO, $3B_2O_3$ +$6H_2O$.

Min. *Hydroboracite.* Somewhat sol. in H_2O. Easily sol. in warm HCl+Aq or HNO_3+Aq.

3CaO, 3MgO, $4B_2O_3$. (Ditte, C. R. **77.** 894.)

Calcium sodium borate, $Ca_3B_{10}O_{18}$, $Na_3B_5O_9$+15, or $24H_2O$.

Min. *Natroborocalcite, Ulexite.* Decomp. by boiling with H_2O. Sol. in acids.

$Ca_2Na_4B_{12}O_{22}+15H_2O$. Min. *Franklandite.* Sl. sol. in H_2O; easily sol. in HCl, and HNO_3 +Aq.

Calcium borate chloride, $Ca_3B_2O_6$, $CaCl_2$.

Decomp. quickly by moist air or H_2O, slowly by absolute alcohol. (Chatelier, C. R. **99.** 276.)

Calcium borate silicate, 2CaO, B_2O_3, $2SiO_2$+ H_2O.

Min. *Datolite.* Sol. in HCl+Aq with separation of gelatinous silica.

+$2H_2O$. Min. *Botryolite.*

CaO, B_2O_3, SiO_2. Min. *Danburite.* Very sl. attacked by HCl+Aq before ignition.

Chromous borate.

Precipitate. Sol. in free acids; insol. in borax+Aq. (Moberg.)

Chromic borate, $7Cr_2O_3$, $4B_2O_3$.

Insol. in H_2O; sol. in excess of borax+Aq. (Hebberling, C. C. **1870.** 122.)

Chromic magnesium borate, $3Cr_2O_3$, 6MgO, $2B_2O_3$.

Not attacked by acids. (Ebelmen, A. ch. (3) **33.** 52.)

$2Cr_2O_3$, 9MgO, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Cobaltous borate, 3CoO, $2B_2O_3+4H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **88.** 299.)

3CoO, B_2O_3. (Mallard, C. R. **105.** 1260.)

Cupric borate, basic.

Composition depends on temperature and concentration of solutions. Boiling H_2O dissolves out all the boric acid. Sol. in acids; slowly sol. in hot conc. NH_4Cl+Aq.

Cupric borate ammonia, CuB_4O_7, $4NH_3$+ $6H_2O$.

Efflorescent. Can be recrystallised from a little NH_4OH+Aq. (Pasternack, A. **151.** 227.)

Didymium borate, $DiBO_3$.

Insol. in H_2O acidulated with HCl+Aq. (Cleve, Bull. Soc. (2) **43.** 363.)

$Di_2(B_4O_7)_3$. Insol. in H_2O; sol. in acids. (Frerichs and Smith, A. **191.** 355.)

Glucinum borate, basic, 5GlO, B_2O_3.

Insol. in H_2O; sol. in acids. (Krüss and Moraht, B. **23.** 735.)

Ferrous borate.

Ppt. H_2O dissolves out all the boric acid. (Tünnerman.)

Ferric borate, $Fe_2(BO_2)_6+3H_2O$.

Ppt. Insol. in H_2O.

Min. *Lagonite.* Sol. in acids.

$2Fe_2O_3$, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

$6Fe_2O_3$, $B_2O_3+6H_2O$. Ppt. (Rose, Pogg. **89.** 473.)

$9Fe_2O_3$, $B_2O_3+9H_2O$. Ppt. (Rose.)

Ferric magnesium borate, $3Fe_2O_3$, 6MgO, $2B_2O_3$.

Insol. in H_2O. Sol. in conc. HCl+Aq. (Ebelmen, A. ch. (3) **33.** 53.)

$2Fe_2O_3$, 9MgO, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Ferroferric magnesium borate, 3MgO, FeO, Fe_2O_3, B_2O_3.

Min. *Ludwigite.* Slowly sol. in HCl+Aq, when finely powdered.

Ferrous borate bromide, 6FeO, $8B_2O_3$, $FeBr_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1445.)

Ferrous borate chloride, 6FeO, $8B_2O_3$, $FeCl_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1195.)

Lanthanum borate, $2La_2O_3$, B_2O_3.

(Nordenskjöld, Pogg. **114.** 618.)

$La_2(B_4O_7)_3$. Ppt. (Smith.)

Formula is $La_2B_6O_{15}+xH_2O$. (Cleve, B. **11.** 910.)

Lead borate, basic,

2PbO, $B_2O_3+2H_2O$. Ppt.

4PbO, $3B_2O_3+4H_2O$. Ppt.

+$5H_2O$. Ppt.

6PbO, $5B_2O_3+6H_2O$. Ppt.

8PbO, $3B_2O_3+8H_2O$. Ppt.

9PbO, $5B_2O_3+9H_2O$. Ppt. (Rose, Pogg. **87.** 470.)

Lead borate, $Pb(BO_2)_2+H_2O$.

Insol. in H_2O. Easily sol. in dil. HNO_3, or boiling $HC_2H_3O_2$+Aq. Decomp. by H_2SO_4, HCl, also by boiling KOH, or NaOH+Aq. Insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Sol. in NH_4Cl+Aq; sol. in sat. NaCl+Aq.

2PbO, $3B_2O_3+4H_2O$. (Herapath.)

$PbB_4O_7+4H_2O$. Slightly sol. in pure H_2O, but insol. in solutions of Na salts as $Na_2B_4O_7$ +Aq. (Soubeiran.)

Lead borate chloride, $Pb(BO_2)_2$, $PbCl_2+H_2O$.

Insol. in cold, very slowly decomp. by hot H_2O into its constituents. Easily sol. in dil. hot HNO_3+Aq; insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Lead borate nitrate, $Pb(BO_2)_2$, $Pb(NO_3)_2+H_2O$.

Insol. in alcohol. (Herapath.)

Lithium borate, $LiBO_2$.

(Reischle.)

$Li_2H_4(BO_3)_2+14H_2O$. (Reischle, Z. anorg. **4.** 166.)

$Li_2B_4O_7$. Deliquescent; easily sol. in H_2O. (Arfvedson, A. ch. **10.** 82.)

$+5H_2O$. Insol. in alcohol. (Filsinger, Arch. Ph. (3) **8.** 198.)

Li_2O, $3B_2O_3+6H_2O$. Sol. in H_2O; insol. in alcohol. (Filsinger.)

Li_2O, $4B_2O_3+10H_2O$. Sol. in H_2O; insol. in alcohol. (Filsinger.)

"Acid lithium borate" is less sol. than the tetraborate. (Gmelin.)

Magnesium borate, $Mg(BO_2)_2$.

(Ditte, C. R. **77.** 893.)

$+3H_2O$. Min. *Pinnoite.*

$+4H_2O$. (Laurent, A. ch. (2) **67.** 215.)

$+8H_2O$. Insol. in cold or hot H_2O; easily sol. in HCl+Aq. Decomp. by conc. HCl +Aq into H_3BO_3 and $MgCl_2$. (Wöhler.)

$MgB_4O_7+8H_2O$. (Popp, A. Suppl. **8.** 1.)

MgO, $3B_2O_3+8H_2O$. Very slowly sol. in H_2O. (Rose, A. **84.** 221.)

Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **49.** 445.)

3MgO, B_2O_3. Insol. in H_2O; easily sol. in acids. (Ebelmen, A. **80.** 208.)

Very sl. sol. in cold, but somewhat decomp. by boiling H_2O. (Rammelsberg.)

$+9H_2O$. Somewhat sol. in cold H_2O. (Wöhler, Pogg. **28.** 525.)

3MgO, $2B_2O_3$. Sol. in warm H_2SO_4 or HNO_3+Aq. (Ditte, C. R. **77.** 893.)

MgO, $6B_2O_3+18H_2O=Mg(BO_2)_2$, $10HBO_2+13H_2O$. (Rammelsberg, Pogg. **49.** 445.)

3MgO, $4B_2O_3$. Sol. in hot dil. acids; insol. in acetic acid. (Ditte, C. R. **77.** 893.)

5MgO, $2B_2O_3+1\frac{1}{2}$, and $3H_2O$. Min. *Szaibelyite.*

Difficultly sol. in HCl+Aq.

9MgO, B_2O_3. (Mallard, C. R. **105.** 260.)

Magnesium manganous borate, $3Mg_2B_2O_5$, $4Mn_2B_2O_5+7H_2O$.

Min. *Sussexite.* Sol. in HCl+Aq.

Magnesium potassium borate.

Easily sol. in H_2O. (Rammelsberg.)

Magnesium sodium borate, $Mg_2B_6O_{11}$, $Na_2B_4O_7+30H_2O$.

Efflorescent. About as sol. in cold H_2O as borax; solution separates out a Mg borate on warming, which redissolves on cooling. Decomp. by boiling H_2O. (Rammelsberg.)

Magnesium strontium borate, 3MgO, 3SrO, $4B_2O_3$.

Easily sol. in dil. acids. (Ditte, C. R. **77.** 895.)

Magnesium borate chloride, $2Mg_3B_8O_{15}$, $MgCl_2$.

Min. *Boracite.* Insol. in H_2O; slowly sol. in acids. (Kraut.)

Stassfurthite. Easily sol. in warm acids. (Bischof.)

Magnesium borate phosphate, $Mg(BO_2)_2$, $2MgHPO_4+7H_2O$.

Min. *Luneburgite.*

Manganous borate, MnB_4O_7 (?).

Insol. in H_2O (Berzelius); very sl. sol. in H_2O (Thomas, Am. Ch. J. **4.** 358); decomp. by warm, slowly by cold H_2O. Sol. in $MgSO_4$ +Aq (Berzelius).

3MnO, B_2O_3. (Mallard, C. R. **105.** 1260.)

3MnO, $2B_2O_3$. (Mallard.)

$MnH_4(BO_3)_2$. Very sl. sol. in H_2O.

Solubility in 2 % Na_2SO_4+Aq. At 18·5°, 0·77 g. $MnH_4(BO_3)_2$ are dissolved per litre; at 40°, 0·65 g.; at 60°, 0·36 g.; at 80°, 0·12 g.

Solubility in 2 % NaCl+Aq. 1 l. solution dissolves 1·31 g. salt at 18·2°; 0·6 g. at 59°; and 0·29 g. at 80°.

Solubility in 2 % $CaCl_2$+Aq. 1 l. $CaCl_2$+Aq dissolves 2·91 g. salt at 17·6°; 2·44 g. at 43·0°; 2·25 g. at 61°; and 1·35 g. at 80°. (Hartley and Ramage, Chem. Soc. **63.** 129.)

Molybdenum borate, MoO_2, $2B_2O_3$ (?).

Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Molybdenum borate, Mo_2O_3, B_2O_3.

Precipitate. Insol. in H_2O; sl. sol. in a solution of boric acid. (Berzelius.)

See **Boromolybdic Acid.**

Nickel borate, $Ni(BO_2)_2+2H_2O$.

Insol. in H_2O. Easily sol. in acids. Easily sol. in warm NH_4Cl+Aq. (Rose, Pogg. **88.** 299.)

2NiO, $B_2O_3+xH_2O$. Easily sol. in acids. (Rose.)

3NiO, $2B_2O_3+5H_2O$. Easily sol. in acids. (Rose.)

Potassium borate, KBO_2.

Sol. in small amount of H_2O. (Berzelius, Pogg. **34.** 568.)

$+1\frac{1}{2}H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Potassium *tetra***borate,** $K_2B_4O_7$.

Very sol. in H_2O.

$+4H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

$+5H_2O$. Very sol. in H_2O; more sol. than $K_2B_6O_{10}$ or $K_2B_{12}O_{19}$.

$+6H_2O$. (Atterberg, *l.c.*)

Potassium *hexa***borate,** $K_2B_6O_{10}+5$, and $8H_2O$.

Easily sol. in H_2O.

Potassium *deka***borate,** $K_2B_{10}O_{16}+8H_2O$.

Sol. in H_2O. (Rammelsberg.)

Potassium *dodeka***borate,** $K_2B_{12}O_{19}+10H_2O$.

Sl. sol. in cold, very sol. in hot H_2O. (Laurent, A. ch. **67.** 215.)

$=K_2B_{10}O_{16}$. (Rammelsberg.)

Potassium borate fluoride, KBO_2, KF.

Sol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

KBO_2, 2KF. Sol. in little, decomp. by much H_2O. Insol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

Rubidium borate, $Rb_2B_4O_7$.

Anhydrous. (Reischle, Z. anorg. **4.** 166.)

$+6H_2O$. Not deliquescent or efflorescent. Sol. in H_2O. (Reissig, A. **127.** 33.)

Samarium borate, $SmBO_3$.

Insol. in H_2O; sol. in HCl+Aq. (Cleve, Bull. Soc. (2) **43.** 1670.)

Silver borate, $AgBO_2+\frac{1}{2}H_2O$.

Sl. sol. in H_2O. By washing with H_2O the boric acid is dissolved out. (Rose, Pharm. Centralbl. **1853.** 205.)

Sol. with decomp. in $Na_2S_2O_3$+Aq (Herschel); sol. in NH_4NO_3+Aq if pptd. cold.

$3Ag_2O$, $4B_2O_3$. (Rose, *l.c.*)

Sodium *meta*borate, $NaBO_2$.

Anhydrous. Easily sol. in H_2O, with evolution of heat.

$+H_2O$. Easily sol. in H_2O. (Benedikt.)

$+2H_2O$. Easily sol. in H_2O. (Benedikt, B. **7.** 703.)

$+3H_2O$. Easily sol. in H_2O. (Berzelius.)

$+4H_2O$. Sl. efflorescent. Sol. in hot, less sol. in cold H_2O. Melts at 57° in its crystal H_2O.

Sodium *tetra*borate, $Na_2B_4O_7$ (*Borax*).

$+4H_2O$.

$+5H_2O$.

$+6H_2O$. Grows opaque in the air. (Bechi, Sill. Am. J. (2) **17.** 129.)

$+10H_2O$. Efflorescent on surface in dry air. Not efflorescent when free from Na_2CO_3. (Sims.)

Sol. in 12 pts. cold, and 2 pts. hot H_2O. Sat. cold $Na_2B_4O_7$+Aq contains 9·23 %, and sat. hot $Na_2B_4O_7$+Aq contains 33·33 % $Na_2B_4O_7$. (Gmelin.)

Sol. in 20 pts. cold, and 6 pts. boiling H_2O. (Wallerius.)

Sol. in 15 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O at 15·5° dissolve 5 pts.; at 65°, 40 pts.; at 100°, 166 pts. $Na_2B_4O_7+10H_2O$. (Ure's Dictionary.)

100 pts. sat. $Na_2B_4O_7$+Aq at 105·5° contain 52·5 pts. $Na_2B_4O_7$, or 100 pts. H_2O dissolve 110·54 pts. $Na_2B_4O_7$, or 1 pt. $Na_2B_4O_7$ is sol. in 0·9047 pt. H_2O at 105·5°. (Griffith, Quar. J. Sci. **18.** 90.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7$ $+10H_2O$	t°	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7$ $+10H_2O$
0	1·49	2·83	60	18·09	40·43
10	2·42	4·65	70	24·22	57·85
20	4·05	7·88	80	31·17	76·19
30	6·00	11·90	90	40·14	116·66
40	8·79	17·90	100	55·16	201·43
50	12·93	27·41	...	...	...

(Poggiale, A. ch. (3) **8.** 46.)

100 pts. H_2O dissolve 1·4 pts. $Na_2B_4O_7$ at 0°, and 55·3 pts. at 100°. (Mulder.)

$Na_2B_4O_7$+Aq sat. at 15° has sp. gr.=1·0199, and contains 3·926 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 471.)

$Na_2B_4O_7$+Aq sat. at 17° has sp. gr.=1·0208. (Stolba, J. pr. **97.** 503.)

Sp. gr. of $Na_2B_4O_7$+Aq at 15°.

% $Na_2B_4O_7$	% $Na_2B_4O_7$ $+10H_2O$	Sp. gr.	% $Na_2B_4O_7$	% $Na_2B_4O_7$ $+10H_2O$	Sp. gr.
1	0·52	1·0049	4	2·11	1·0199
2	1·06	1·0099	5	2·64	1·0249
3	1·59	1·0149	6	3·17	1·0299

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of $Na_2B_4O_7$+Aq sat. at 15°=1·032. (Gerlach.)

Sat. $Na_2B_4O_7$+Aq boils at 105·5°, and contains 110·5 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Griffith.)

Sat. $Na_2B_4O_7$+Aq forms a crust at 103°, and contains 60·14 pts. $Na_2B_4O_7$ to 100 pts. H_2O; highest temp. observed, 104·3°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Na_2B_4O_7$+Aq containing pts. $Na_2B_4O_7$ to 100 pts. H_2O.

B.-pt.	Pts. $Na_2B_4O_7$	B.-pt.	Pts. $Na_2B_4O_7$
100·5°	8·64	103·0°	61·2
101·0	17·2	103·5	75·4
101·5	26·5	104·0	90·8
102·0	37·5	104·5	109·0
102·5	48·5	104·6	112·3

(Gerlach, Z. anal. **26.** 452.)

M.-pt. of $Na_2B_4O_7+10H_2O$ is 75·5°. (Tilden, Chem. Soc. **45.** 407.)

Insol. in alcohol.

Sol. in alcoholic solution of $NaC_2H_3O_2$. (Stromeyer.)

Sol. in 14·7 pts. glycerine of 1·225 sp. gr. (Vogel.)

Sol. in 1 pt. glycerine. (Schultze, Arch. Pharm. (3) **6.** 149.)

Min. *Tincal.*

Sodium borate, $Na_2B_8O_{13}+10H_2O$.

Sol. in 5-6 pts. cold H_2O. (Bolley, A. **68.** 122.) Perhaps sodium hydrogen tetraborate $NaHB_4O_7+4\frac{1}{2}H_2O$.

$Na_2B_{10}O_{16}+11H_2O$. (Laurent, C. R. **29.** 5.)

Sodium borate fluoride, $NaBO_2$, $3NaF+4H_2O$.

Sol. in H_2O.

Basarow (B. **7.** 112) considers this salt to be a mixture.

$Na_2B_4O_7$, $12NaF+22H_2O$. Can be separated into its constituents by H_2O. (Berzelius, Berz. J. B. **23.** 96.)

Strontium borate, $Sr(BO_2)_2$.

(Ditte, C. R. **77.** 788.)

SrB_4O_7. Sol. in 130 pts. boiling H_2O. 100 pts. H_2O at 100° dissolve 7·7 pts. (Ure's Dict.). Easily sol. in cold NH_4 salts+Aq; sol. in cold HNO_3+Aq. When precipitated and dried at 100° contains $4H_2O$.

SrB_6O_{10}. Very sl. sol. in H_2O; sol. in acids. (Laurent.)

$SrB_8O_{13}+7H_2O$. Ppt. (Laurent.)

$Sr_3B_4O_9$. Sol. in cold mineral acids and acetic acid. (Ditte, C. R. **77.** 785.)

$2SrO, 3B_2O_3$. Easily sol. in acids. (Ditte, *l.c.*)

Thallous borate.

Ppt. Sol. in boiling H_2O; insol. in cold dil. H_2SO_4+Aq. (Crookes.)

Thorium borate (?).

Precipitate. Insol. in H_2O and H_3BO_3+Aq. (Berzelius.)

Stannous borate (?).

Ppt. (Wenzel.)

***Di*vanadyl borate.**

Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Yttrium borate.

Precipitate. (Berlin, Pogg. **43.** 105.)

Zinc borate, $3ZnO, 2B_2O_3$.

(Mallard, C. R. **105.** 1260.)

$9ZnO, 4B_2O_3+9H_2O$. Sl. sol. in H_3BO_3 +Aq. (Rose, Pogg. **88.** 299.)

$3ZnO, B_2O_3$. Insol. in mineral acids. (le Chatelier, C. R. **113.** 1034.)

Zinc borate ammonia, $ZnB_4O_7, 4NH_3+6H_2O$.

Easily sol. in NH_4OH, $HC_2H_3O_2$, H_2SO_4, HCl, and HNO_3+Aq. (Büchner, A. **151.** 234.)

Zinc borate bromide, $6ZnO, 8B_2O_3, ZnBr_2$.

(Rousseau and Allaire, C. R. **116.** 1446.)

Zirconium borate (?).

Insol. in H_2O.

Boric phosphoric acid.

See **Phosphoboric acid.**

Boric acid sulphur *tri*oxide.

See **Borosulphuric acid.**

Borofluorhydric acid, HBF_4.

See **Fluoboric acid.**

Borofluorides.

See **Fluoborides.**

Boromolybdic acid.

Sol. in H_2O. Decomp. by alcohol. (Berzelius.)

Boron, B.

(*a*) *Amorphous.* Somewhat sol. in pure H_2O, when not ignited. Salts and acids separate it out of aqueous solution. Upon evaporation of H_2O solution a crust is formed, which is only partially sol. in H_2O. (Berzelius, Pogg. **2.** 113.) Decomp. by hot H_2SO_4 and cold moderately conc. HNO_3+Aq. Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd., and is insol. in H_2O. (Berzelius.) Insol. in caustic alkalies+Aq; also in alcohol and ether.

Above boron was very impure. (Moissan, C. R. **114.** 392.)

Pure B is not attacked by acids, but has a strong reducing action on $KMnO_4$+Aq, $FeCl_3$ +Aq, etc. (Moissan, C. R. **114.** 617.)

(*b*) *Crystallised.* 1. Insol. in H_2O, HCl, or KOH+Aq. Very slightly and slowly attacked by boiling conc. H_2SO_4. Gradually sol. in hot conc. HNO_3. Formula is Al_2B_{24}. (Hampe, A. **183.** 75.)

2. Very slightly attacked by conc. HCl or H_2SO_4; slowly but completely sol. in conc. HNO_3; insol. in KOH + Aq. Formula is $C_2Al_3B_{48}$. (Hampe.)

Boron *tri*bromide, BBr_3.

Sol. in H_2O or alcohol with decomp. (Nicklès, C. R. **60.** 800.)

Boron phosphorus bromide, BBr_3, PBr_3.

Decomp. by H_2O.

Sol. in CS_2, and $CHCl_3$. Decomp. by alcohol, ether, etc. (Tarible, C. R. **116.** 1521.)

BBr_3, PBr_5. Sl. sol. in cold, easily in hot CS_2. (Tarible.)

Boron bromide ammonia, $BBr_3, 4NH_3$.

Decomp. by H_2O and alkalies. (Besson, C. R. **114.** 542.)

Boron bromide phosphine, BBr_3, PH_3.

Violently decomp. by H_2O. (Besson, C. R. **113.** 78.)

Boron bromoiodide, BBr_2I.

Decomp. violently by H_2O. (Besson, C. R. **112.** 100.)

$BBrI_2$. (Besson, C. R. **112.** 100.)

Boron carbide, BC or B_2C_2.

Insol. in all the usual solvents. (Müllhäuser, Z. anorg. **5.** 92.)

Boron *tri*chloride, BCl_3.

Rapidly absorbed by H_2O and alcohol with decomposition.

Boron nitrosyl chloride, BCl_3, NOCl.

Decomp. violently by H_2O. (Geuther, J. pr. (2) **8.** 854.)

Boron phosphoryl chloride, $BCl_3, POCl_3$.

Decomp. immediately by H_2O. (Gustavson, Zeit. Chem. **1870.** 521.)

Boron chloride ammonia, $2BCl_3, 3NH_3$.

Decomp. by H_2O. (Berzelius, Pogg. **2.** 147.)

Boron chloride phosphine, BCl_3, PH_3.

Decomp. by H_2O. (Besson, C. R. **110.** 516.)

Boron *tri*fluoride, BF_3.

H_2O absorbs 700 vols. BF_3 gas to form a liquid of 1·77 sp. gr. On boiling, $\frac{1}{5}$ of the BF_3 is given off, and a residue boiling at 165-200°, with composition BF_3+2H_2O or HBO_2+3HF, is left. (J. Davy, A. ch. **86.** 178.)

1 ccm. H_2O absorbs at 0° and 762 mm. pressure 1057 ccm. BF_3.

1 vol. conc. H_2SO_4 of 1·85 sp. gr. absorbs 50 vols. BF_3.

Absorbed by alcohol with decomp.

Cold oil of turpentine absorbs 6·8 % of BF_3.

Boron fluoride ammonia, BF_3,NH_3, BF_3, $2NH_3$, and BF_3, $3NH_3$.

Decomp. by H_2O.

Boron fluoride cyanhydric acid, BF_3, HCN.

Very unstable. (Patein, C. R. **113.** 85.)

Boron fluoride phosphine, $2BF_3$, PH_3.

Very unstable at ordinary temp. Decomp. by H_2O. (Besson, C. R. **110.** 80.)

Boron hydride, BH_3.

Not obtained free from H. Sl. sol. in H_2O. (Jones, Chem. Soc. **35.** 41.)

Boron iodide, BI_3.

Very hygroscopic, and instantly decomp. by H_2O or alcohol. Very sol. in CS_2, CCl_4, C_6H_6; less sol. in PCl_3, $AsCl_3$, and a great many organic liquids. (Moissan, C. R. **112.** 717.)

Boron iodide ammonia, BI_3, $5NH_3$.

Decomp. by H_2O. (Besson, C. R. **114.** 542.)

Boron iodophosphide, BI_2P.

Very hygroscopic; decomp. by H_2O. Not attacked by cold conc. H_2SO_4, even if fuming, but on heating decomposition takes place. Very sl. sol. in CS_2. Insol. in benzene, PCl_3, or CCl_4. (Moissan, C. R. **113.** 624.)

BIP. Less hygroscopic than BI_2P, but otherwise the properties are similar. (Moissan.)

Boron nitride, BN.

Insol. in H_2O, conc. HNO_3, conc. HCl+Aq, or conc. solutions of alkalies.

Decomp. by hot conc. H_2SO_4 or HF. (Wöhler, A. **74.** 70.)

Boron *tri*oxide, B_2O_3.

Deliquescent. Sol. in H_2O with a large increase in temp. (Ditte, C. R. **85.** 1069.)

1 pt. dissolves—

at	18·75°	in	47·01	pts.	H_2O.
,,	25°	,,	27·75	,,	,,
,,	37·5°	,,	18·73	,,	,,
,,	50°	,,	15·13	,,	,,
,,	62·5°	,,	9·29	,,	,,
,,	75°	,,	7·28	,,	,,
,,	87·5°	,,	5·58	,,	,,
,,	100°	,,	4·74	,,	,,

Or 100 pts. H_2O dissolve—

at	18·75°	2·13	pts.	B_2O_3.
,,	25°	3·60	,,	,,
,,	37·5°	4·24	,,	,,
,,	50°	6·61	,,	,,
,,	62·5°	10·76	,,	,,
,,	75°	13·73	,,	,,
,,	87·5°	17·92	,,	,,
,,	100°	21·09	,,	,,

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves—

at	0°	11·00	g.	B_2O_3.
,,	12°	16·50	,,	,,
,,	20°	22·49	,,	,,
,,	40°	39·50	,,	,,
,,	62°	64·50	,,	,,
,,	80°	95·00	,,	,,
,,	102°	164·50	,,	,,

(Ditte, C. R. **85.** 1069.)

Sat. H_2O solution boils at 100°. (Brandes and Firnhaber.)

Sat. H_2O solution boils at 103·3°. (Griffiths, Quar. J. Sci. **18.** 90.)

Sol. in acetic acid, hot conc. HCl+Aq, HNO_3, and H_2SO_4. From the three latter it separates on cooling or dilution with H_2O.

Insol. in alcohol. (Graham.)

Sol. in alcohol. (Berzelius, Ebelmen.)

Sol. in oils.

See also **Boric acid.**

Boron *tri*oxide potassium fluoride, B_2O_3, 2KF.

Gradually sol. in H_2O. Decomp. by much H_2O. Insol. in alcohol. (Schiff and Sestini, A. **228.** 82.)

Boron oxychloride, BOCl.

(Gustavson, Zeit. Chem. **1870.** 521.)

$BOCl_3$. Slowly decomp. by H_2O. (Councler, J. pr. (2) **18.** 399.)

Oxychlorides of either the above formulæ do not exist; the true formula for boron oxychloride is $B_8O_{11}Cl_2$. (Lorenz, A. **247.** 226.)

Boron phosphide, BP.

Insol. in H_2O. Sol. in conc. boiling alkalies +Aq with decomp. Decomp. by HNO_3+Aq. (Besson, C. R. **113.** 78.)

Insol. in PCl_3, $AsCl_3$, $SbCl_3$, CCl_4, and in fact in all known solvents.

Not attacked by boiling H_2O, conc. HCl, or HI+Aq. Sol. in conc. HNO_3 with decomp. on heating. Not attacked by cold H_2SO_4. (Moissan, C. R. **113.** 726.)

B_5P_3. Not attacked by boiling conc. HNO_3 +Aq. Insol. in all solvents. (Moissan.)

Boron phosphoiodide.

See **Boron iodophosphide.**

Boron selenide, B_2Se_3.

Violently decomp. by H_2O. (Sabatier, C. R. **112.** 1000.)

Boron *tri*sulphide, B_2S_3.

Decomp. with violence with H_2O. Combines with alcohol and ether. (Fremy, A. ch. (3) **38.** 312.)

Insol. in most solvents, but sl. sol. in PCl_3 without decomp.; more sol. in SCl_2, but does not crystallise from the solution. (Moissan, C. R. **115.** 203.)

Boron *penta*sulphide, B_2S_5.

Decomp. by H_2O and alcohol. (Moissan, C. R. **115.** 271.)

Borosulphuric acid, $BOHSO_4+SO_3$.

Decomp. by H_2O. (Schultz-Sellac, B. **4.** 12.)

$B(HSO_4)_3$. Very deliquescent. Easily sol. in fuming H_2SO_4. (D'Arcy, Chem. Soc. **55.** 155.)

Boro*nono*tungstic acid, $H_4B_2W_9O_{32}+22H_2O=9WO_3, B_2O_3, 2H_2O+22H_2O$.

Sol. in less than $\frac{1}{9}$ pt. H_2O, and as easily sol. in alcohol and ether. Sp. gr. of aqueous solution is somewhat under 3. (Klein, A. ch. (5) **28.** 370.)

Aluminum boro*nono*tungstate, $Al_4(B_2W_9O_{32})_3 + 70H_2O$.

Extremely sol. in H_2O. (Klein.)

Ammonium ——, $(NH_4)_4B_2W_9O_{32} + 18H_2O$.

Quickly effloresces. (Klein.)

Barium ——, $Ba_2B_2W_9O_{32} + 18H_2O$.

Sol. in 4 pts. cold, and less than ½ pt. hot H_2O. (Klein.)

Cadmium ——, $Cd_2B_2W_9O_{32} + 18H_2O$.

Deliquescent.

100 pts. of salt dissolve in less than 8 pts. H_2O at 19°. Sp. gr. of solution is 3·28. (Klein.)

Calcium ——, $Ca_2B_2W_9O_{32} + 15H_2O$.

Sol. in $\frac{1}{10}$ pt. H_2O. Solution has sp. gr. = 3·10. (Klein.)

Cerium ——, $Ce_4(B_2W_9O_{32})_3 + 57H_2O$.

Very sol. in H_2O; sp. gr. of solution is over 3.

Chromium ——, $Cr_4(B_2W_9O_{32})_3 + 65H_2O$.

Very sol. in H_2O; sp. gr. of solution is 2·80. (Klein.)

Cobalt ——, $Co_2B_2W_9O_{32} + 18H_2O$.

Very sol. in H_2O; sp. gr. of solution sat. at 19° = 3·36. (Klein.)

Copper ——, $Cu_2B_2W_9O_{32} + 19H_2O$.

25 pts. H_2O dissolve 100 pts. salt. Sp. gr. of solution = 2·6. (Klein.)

Lead ——, $Pb_2B_2W_9O_{32} + 11H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. (Klein.)

Lithium —— (?).

Very sol. in H_2O. Sp. gr. of solution is about 3.

Magnesium ——, $Mg_2B_2W_9O_{32} + 22H_2O$.

Very sol. in H_2O. (Klein.)

Manganous ——, $Mn_2B_2W_9O_{32} + 17H_2O$.

100 pts. dissolve in 13 pts. H_2O. Sp. gr. of solution at 19° = 3·15. (Klein.)

Mercurous ——, $3Hg_2O, B_2O_3, 9WO_3 + 14H_2O$ (?).

Precipitate.

Insol. in H_2O. (Klein.)

Sol. in 20,000 pts. dil. cold, and 1000 pts. boiling HNO_3 + Aq of 1·42 sp. gr.

Nickel ——, $Ni_2B_2W_9O_{32} + 18H_2O$.

Very sol. in H_2O; sp. gr. of sat. solution at 19° = 3·32.

Potassium ——, $K_4B_2W_9O_{32} + 13H_2O$.

5 pts. salt dissolve in 8 pts. H_2O at 19° to form a solution of 1·38 sp. gr. The solution sat. at 100° has sp. gr. of over 2. (Klein.)

Silver ——, $Ag_4B_2W_9O_{32} + 14H_2O$.

Very sl. sol. in H_2O.

Sodium ——, $Na_2H_2B_2W_9O_{32} + 22H_2O$.

Very sol. in H_2O. Solution sat. at 19° contains 84 pts. salt to 16 pts. H_2O. (Klein.)

$Na_4B_2W_9O_{32} + 11H_2O$. Sol. in less than ⅓ pt. H_2O.

Thallium boro*nono*tungstate, $Tl_2B_2W_9O_{32} + 5H_2O$.

Sl. sol. in hot H_2O and nearly insol. in cold H_2O. (Klein.)

Uranium ——, $(UO_3)_3(B_2W_9O_{30})_2 + 30H_2O$.

Very sol. in H_2O. (Klein.)

Sp. gr. of solution = 3·1.

Zinc ——, $Zn_2B_2W_9O_{32} + 2H_2O$.

Very sol. in H_2O. Sp. gr. of solution = 3·15. (Klein.)

Boro*deci*tungstic acid.

Barium boro*deci*tungstate, $Ba_2B_2W_{10}O_{35} + 20H_2O$.

Sol. in H_2O. (Klein, C. R. **99**. 35.)

Boro*duodeci*tungstic acid, $H_8B_2W_{12}O_{43} = 4H_2O, B_2O_3, 12WO_3$.

Known only in solution, which decomposes into boro*nono*tungstic acid and tungstic acid, when evaporated to a certain concentration. (Klein, C. R. **99**. 35.)

Barium potassium boro*duodeci*tungstate, $3BaO, K_2O, B_2O_3, 12WO_3 + 28H_2O$.

Potassium ——, $K_8B_2W_{12}O_{43} + 21H_2O$.

Sol. in H_2O. (Klein.)

Boro*quatuordeci*tungstic acid, $H_{12}B_2W_{14}O_{51} = 6H_2O, B_2O_3, 14WO_3$.

Has not been obtained in the free state. (Klein, A. ch. (5) **28**. 353.)

Barium boro*quatuordeci*tungstate, $Ba_3B_2W_{14}O_{48} = 3BaO, B_2O_3, 14WO_3 + 5H_2O$.

Sl. sol. in H_2O. (Klein.)

Barium sodium ——, $3\frac{1}{2}BaO, 1\frac{1}{2}Na_2O, 5H_2O, B_2O_3, 14WO_3 + 29H_2O$.

Potassium ——, $3K_2O, H_2O, B_2O_3, 14WO_3 + 22H_2O$.

Sol. in H_2O. (Klein.)

Silver ——, $Ag_6H_2B_2W_{14}O_{49} + 7H_2O$.

Nearly insol. in cold H_2O. (Klein.)

Sodium ——, $Na_4H_8B_2W_{14}O_{51} + 25H_2O$.

Sol. in H_2O. (Klein.)

Sodium strontium ——, $3\frac{1}{2}SrO, 1\frac{1}{2}Na_2O, B_2O_3, 14WO_3 + 29H_2O$.

Decomp. by H_2O. (Klein.)

Borovanadic acid.

Sol. in H_2O. Easily decomp. (Guyard, Bull. Soc. (2) **25**: 354.)

Bromarsenious acid.

See **Arsenyl bromide.**

Bromauric acid, $HAuBr_4 + 5H_2O$.

Very sol. in H_2O. (Thomsen, J. pr. (2) **13**. 337.)

Barium bromaurate.

Not deliquescent. Sol. in H_2O. (v. Bonsdorff, Pogg. **17**. 261.)

Cæsium bromaurate, $CsAuBr_4$.

Sl. sol. in H_2O or alcohol. Insol. in ether. (Wells and Wheeler, Sill. Am. J. **144**. 157.)

Cerium bromaurate, $CeAuBr_6+8H_2O$.

Sol. in H_2O. (Jolin, Bull. Soc. (2) **21**. 533.)

Didymium bromaurate, $DiAuBr_6+9H_2O$.

Very deliquescent. Sol. in H_2O. (Cleve.)

Lanthanum bromaurate, $LaAuBr_6+9H_2O$.

Sol. in H_2O. (Cleve.)

Magnesium bromaurate.

Deliquescent in moist air. (v. Bonsdorff.)

Manganese bromaurate.

Deliquescent. (v. Bonsdorff.)

Potassium bromaurate, $KAuBr_4$.

Sl. sol. in H_2O. More sol. in cold alcohol than in H_2O. (v. Bonsdorff.)

$+2H_2O$. Sol. in 5·12 pts. H_2O at 15°, 1·56 pts. at 40°, and 0·48 pt. at 67°. Decomp. by ether. Sl. sol. in KBr+Aq. (Schottländer, A. **217**. 314.)

$+5H_2O$. Efflorescent. (v. Bonsdorff.)

Rubidium bromaurate, $RbAuBr_4$.

As cæsium bromaurate.

Samarium bromaurate, $SmAuBr_6+10H_2O$.

Very deliquescent. (Cleve, Bull. Soc. (2) **43**. 165.)

Sodium bromaurate, $NaAuBr_4$.

Slowly sol. in H_2O. (v. Bonsdorff.)

Zinc bromaurate, $Zn(AuBr_4)_2$.

Very deliquescent. (v. Bonsdorff.)

Bromauricyanhydric acid.

Not known in free state.

Barium bromauricyanide, $Ba[Au(CN)_2Br_2]_2+10H_2O$.

Very sol. in hot or cold H_2O, also in alcohol. (Lindbom, Lund. Univ. Arsk. **12**. No. 6.)

Cadmium bromauricyanide, $Cd[Au(CN)_2Br_2]_2+6H_2O$.

Very sol. in hot or cold H_2O, but solution is unstable. (Lindbom.)

Calcium bromauricyanide, $Ca[Au(CN)_2Br_2]_2+10H_2O$.

Extremely sol. in H_2O and alcohol. (Lindbom.)

Cobalt bromauricyanide, $Co[Au(CN)_2Br_2]_2+9H_2O$

Moderately sol. in H_2O. Less sol. than other bromauricyanides. (Lindbom.)

Potassium bromauricyanide, $KAu(CN)_2Br_2+3H_2O$.

Sol. in H_2O and alcohol.

Sodium bromauricyanide, $NaAu(CN)_2Br_2+2H_2O$.

Very sol. in H_2O or alcohol.

Strontium bromauricyanide, $Sr[Au(CN)_2Br_2]_2+xH_2O$.

Very sol. in H_2O or alcohol.

Zinc bromauricyanide, $Zn[Au(CN)_2Br_2]_2+8H_2O$.

Easily sol. in cold or hot H_2O.

Bromhydric acid, HBr.

Very sol. in H_2O.

The most concentrated HBr+Aq has a sp. gr. of 1·78, and contains 82·02 % HBr. (Champion and Pellat, C. R. **70**. 620.) This, or a weak acid on heating leaves a residue, which distils unchanged at 125-125·5° under 758 mm. pressure, and contains 48·17 % HBr (Topsoë); at 126° under 758 mm. pressure, and contains 46·83 % HBr (Bineau); and has sp. gr. = 1·486 at 20° (Bineau); sp. gr. = 1·48 at 20° (Champion and Pellat); sp. gr. = 1·49 at 20° (Topsoë).

According to Roscoe (A. **116**. 214) an acid of constant composition, obtained by boiling a stronger or a weaker acid, if distilled under 752-762 mm. pressure, contains 47·38-47·86 % HBr, and boils at 126° at 760 mm. pressure; but the composition is dependent on the pressure, as, for example, under 1952 mm. pressure, the residue boils at 153°, and contains 46·3 % HBr. (Roscoe.)

By conducting dry air through HBr+Aq an acid is obtained containing 51·65 % HBr if at 16°, and 49·35 % HBr if at 100° (Roscoe.)

1 vol. H_2O dissolves 600± vols. HBr at 10°. (Berthelot, C. R. **76**. 679.)

1 pt. H_2O at t° and 760 mm. pressure dissolves pts. HBr.

t°	Pts. HBr	t°	Pts. HBr	t°	Pts. HBr
−25	2·550	−5	2·280	+50	1·715
−20	2·473	0	2·212	+75	1·505
−15	2·390	+10	2·103	+100	1·300
−10	2·335	+25	1·930	...	...

(Roozeboom, R. t. c. **4**. 107.)

Absorption by 1 pt. H_2O at t° and p pressure in mm.

t° = −25°.

p	Pts. HBr	p	Pts. HBr
760	2·550	100	2·056
300	2·263	1	1·755
140	2·120	0·5	1·10

t° = −20°.

p	Pts. HBr	p	Pts. HBr
760	2·473	130	2·056
375	2·267	20	1·850
180	2·119	...	...

t° = −15°.

p	Pts. HBr	p	Pts. HBr
760	2·390	175	2·056
470	2·266	102	1·980
250	2·119	...	...

t° = −11·3°.

p	Pts. HBr	p	Pts. HBr
760	2·350	310	2·118
570	2·265	216	2·055

t° = −5°.

p	Pts. HBr	p	Pts. HBr
760	2·280	430	2·117
730	2·264	298	2·055

t° = 0°.

p	Pts. HBr	p	Pts. HBr
760	2·212	380	2·054
540	2·116	5	1·085

(Roozeboom, R. t. c. **4**. 107.)

Sp. gr. of HBr + Aq.

Sp. gr.	% HBr	Temp.	Sp. gr.	% HBr	Temp.
1·055	7·67	14°	1·335	36·67	13°
1·075	10·19	14°	1·349	37·86	13°
1·089	11·94	14°	1·368	39·13	13°
1·097	12·96	14°	1·419	43·12	13°
1·118	15·37	14°	1·431	43·99	13°
1·131	16·92	14°	1·438	44·62	13°
1·164	20·65	14°	1·451	45·45	14°
1·200	24·35	13°	1·460	46·09	13°
1·232	27·62	13°	1·485	47·87	14°
1·253	29·68	13°	1·490	48·17	14°
1·302	33·84	13°	...	...	...

(Topsoë, B. **3**. 404.)

Sp. gr. of HBr + Aq at 14°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1·007	18	1·140	35	1·314
2	1·014	19	1·149	36	1·326
3	1·021	20	1·158	37	1·338
4	1·028	21	1·167	38	1·351
5	1·035	22	1·176	39	1·363
6	1·043	23	1·186	40	1·376
7	1·050	24	1·196	41	1·389
8	1·058	25	1·206	42	1·403
9	1·065	26	1·215	43	1·417
10	1·073	27	1·225	44	1·431
11	1·081	28	1·235	45	1·445
12	1·089	29	1·246	46	1·459
13	1·097	30	1·257	47	1·473
14	1·106	31	1·268	48	1·487
15	1·114	32	1·279	49	1·502
16	1·122	33	1·290	...	...
17	1·131	34	1·302	...	...

(Topsoë, calculated by Gerlach, Z. anal. **27**. 316.)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
5	1·038	25	1·204	45	1·435
10	1·077	30	1·252	50	1·515
15	1·177	35	1·305	...	...
20	1·159	40	1·365	...	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. **23**. 242.)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1·0082	18	1·145	35	1·314
2	1·0155	19	1·154	36	1·326
3	1·0230	20	1·163	37	1·338
4	1·0305	21	1·172	38	1·350
5	1·038	22	1·181	39	1·362
6	1·046	23	1·190	40	1·375
7	1·053	24	1·200	41	1·388
8	1·061	25	1·209	42	1·401
9	1·069	26	1·219	43	1·415
10	1·077	27	1·229	44	1·429
11	1·085	28	1·239	45	1·444
12	1·093	29	1·249	46	1·459
13	1·102	30	1·260	47	1·474
14	1·110	31	1·270	48	1·490
15	1·119	32	1·281	49	1·496
16	1·127	33	1·292	50	1·513
17	1·136	34	1·303	...	...

(Biel, C. C. **1882**. 148.)

Absorbed by alcohol with formation of C_2H_5Br.

+H_2O. (Roozeboom, R. t. c. **5**. 363.)
+$2H_2O$. (Berthelot, A. ch. (5) **14**. 369.)

Bromhydric cyanhydric acid, 3HBr, 2HCN.

Decomp. by H_2O and alcohol.

Insol. in ether. (Gautier, A. ch. (4) **17**. 141.)

Bromic acid, $HBrO_3$.

Known only in aqueous solution.

Solution evaporated on water bath decomposes when it contains 4·26 % $HBrO_3$. In vacuo, an acid containing 50·59 % $HBrO_3$ corresponding to formula $HBrO_3 + 7H_2O$ can be obtained.

Not decomp. by dil. HNO_3, or H_2SO_4 + Aq. Conc. H_2SO_4 decomposes.

Alcohol and ether are quickly oxidised by $HBrO_3$.

Bromates.

Most of the bromates are very sol. in H_2O, a few are sl. sol., but none are insol., the least sol. being $AgBrO_3$ and $Hg_2(BrO_3)_2$.

Aluminum bromate, $Al(BrO_3)_3$.

Deliquescent. (Rammelsberg, Pogg. **55**. 63.)

Ammonium bromate, NH_4BrO_3.

Decomposes spontaneously; sol. in H_2O. (Rammelsberg, Pogg. **52**. 85.)

Barium bromate, $Ba(BrO_3)_2+H_2O$.

Sol. in 130 pts. cold, and 24 pts. boiling H_2O. (Rammelsberg, Pogg. **52.** 81.)

Decomp. by H_2SO_4, or HCl+Aq.

Bismuth bromate.

Known only in solution, which decomp. on evaporation. (Rammelsberg, Pogg. **55.** 76.)

Cadmium bromate, $Cd(BrO_3)_2+H_2O$.

Sol. in 0·8 pt. cold H_2O. (Rammelsberg, Pogg. **55.** 74.)

Cadmium bromate ammonia, $Cd(BrO_3)_2$, $3NH_3$.

Decomp. by H_2O. (Rammelsberg, Pogg. **55.** 74.)

Calcium bromate, $Ca(BrO_3)_2+H_2O$.

Sol. in 1·1 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 98.)

Cerous bromate, $Ce(BrO_3)_3+9H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **55.** 63.)

Cobaltous bromate, $Co(BrO_3)_2+6H_2O$.

Sol. in 2·2 pts. cold H_2O; sol. in NH_4OH + Aq. (Rammelsberg, Pogg. **55.** 71.)

Cupric bromate, basic, 6CuO, $Br_2O_5+10H_2O$.

Ppt. (Rammelsberg, Pogg. **55.** 78.)

Cupric bromate, $Cu(BrO_3)_2+6H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **52.** 92.)

Cupric bromate ammonia, $Cu(BrO_3)_2$, $4NH_3$.

Completely sol. in a little H_2O, but decomp. by dilution.

Insol. in alcohol. (Rammelsberg, Pogg. **52.** 92.)

Didymium bromate, $Di(BrO_3)_3+9H_2O$.

Sol. in H_2O. (Marignac.)

Erbium bromate, $Er(BrO_3)_3+9H_2O$.

Very sol. in alcohol and H_2O.

Glucinum bromate.

Deliquescent.

Ferrous bromate, $Fe(BrO_3)_2$.

Sol. in H_2O, but solution decomp. very easily.

Ferric bromate, $5Fe_2O_3$, $Br_2O_5+30H_2O$.

Partially sol. in H_2O, with separation of a more basic salt. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **55.** 68.)

Lanthanum bromate, $La(BrO_3)_3+9H_2O$.

Sol. in 3½ pts. H_2O at 15°. (Marignac, Ann. Min. (5) **15.** 274.)

Lead bromate, $Pb(BrO_3)_2+H_2O$.

Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 96.)

Lithium bromate, $LiBrO_3$.

Very deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. A. **55.** 63.)

Not deliquescent. (Potilitzin, B. **23.** 545 R.)

$+H_2O$. Not deliquescent. (Potilitzin.)

Magnesium bromate, $Mg(BrO_3)_2+6H_2O$.

Efflorescent. Sol. in 1·4 pts. cold H_2O at 15°. Melts in its water of crystallisation when heated. (Rammelsberg, Pogg. **52.** 89.)

Mercurous bromate, basic, $2Hg_2O$, Br_2O_5.

Insol. in warm H_2O. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercurous bromate, $Hg_2(BrO_3)_2$.

Decomp. by H_2O into basic salt. Difficultly sol. in HNO_3+Aq; easily sol. in HCl+Aq. (Rammelsberg.)

Mercuric bromate, basic, 2HgO, $Br_2O_5+H_2O$.

Slowly decomp. by cold, quickly by hot H_2O into oxide and an acid salt.

Easily sol. in dil. acids. (Topsoë, W. A. B. **66,** 2. 2.)

Mercuric bromate, $HgBrO_3+2H_2O$.

Sol. in 650 pts. cold, and 64 pts. boiling H_2O. Sl. sol. in HNO_3+Aq. Easily sol. in HCl+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercuric bromate ammonia.

Sol. with decomp. in HCl+Aq. (Storer's Dict.)

Nickel bromate, $Ni(BrO_3)_2+6H_2O$.

Sol. in 3·58 pts. cold H_2O. (Rammelsberg, Pogg. **55.** 69.)

Nickel bromate ammonia, $Ni(BrO_3)_2$, $2NH_3$.

Sol. in H_2O, with decomposition of the major portion. Insol. in alcohol. (Rammelsberg, *l.c.*)

Potassium bromate, $KBrO_3$.

100 pts. H_2O dissolve 6·58 pts. $KBrO_3$ at 15° (Rammelsberg). 100 pts. H_2O dissolve 5·83 pts. $KBrO_3$ at 17·1° (Pohl. W. A. B. **6.** 595); at 0°, 3·11 pts.; at 20°, 6·92 pts.; at 40°, 13·24 pts.; at 60°, 22·76 pts.; at 80°, 33·90 pts.; at 100°, 49·75 pts. $KBrO_3$. Sat. solution boils at 104°. (Kremers, Pogg. **97.** 5.)

Sp. gr. of $KBrO_3$+Aq at 19·5°.

% $KBrO_3$	1	2	3	4	5
Sp. gr. . .	1·009	1·016	1·024	1·031	1·039
% $KBrO_3$	6	7	8	9	10
Sp. gr. . .	1·046	1·054	1·062	1·070	1·079

(Gerlach, Z. anal. **8.** 290.)

Sl. sol. in alcohol. (Rammelsberg.)

Insol. in absolute alcohol.

Silver bromate, $AgBrO_3$.

1 pt. H_2O dissolves 0·00810 pt. $AgBrO_3$ at 24·5°. (Noyes, Z. phys. Ch. **6.** 246.)

Sol. in 505·3 pts. H_2O at 25°.

Sol. in 320·4 pts. HNO_3+Aq (sp. gr. 1·21) at 25°.

Sol. in 2·2 pts. NH_4OH+Aq (sp. gr. 0·96) at 25°. (Longi, Gazz. ch. it. **13.** 87.)

Insol. in HNO_3. (Löwig.) Easily sol. in NH_4OH+Aq.

Silver bromate ammonia, $AgBrO_3$, $2NH_3$.

Decomp. in air or by H_2O. (Rammelsberg, Pogg. **52.** 94.)

Sodium bromate, $NaBrO_3$.

Sol. in 2·7 pts. H_2O at 15°. (Rammelsberg.)
100 pts. H_2O dissolve at—

0°	20°	40°	60°	80°	100°	
27·54	34·48	50·25	62·5	75·75	90·9	pts. $NaBrO_3$.

(Kremers, Pogg. **94.** 271.)

Easily forms supersaturated solutions.
Sat. solution boils at 109°. (Kremers.)

Sp. gr. of $NaBrO_3+Aq$ at 19·5°.

% $NaBrO_3$.	5	10	15
Sp. gr. . .	1·041	1·083	1·129
% $NaBrO_3$.	20	25	30
Sp. gr. . .	1·178	1·231	1·289

(Kremers, Pogg. **97.** 5, calculated by Gerlach, Z. anal. **8.** 290.)

Sodium bromate bromide, $3NaBrO_3, 2NaBr+3H_2O$.

Decomp. by H_2O or alcohol. (Fritzsche.)
$2NaBrO_3, NaBr+2H_2O$.

Strontium bromate, $Sr(BrO_3)_2+H_2O$.

Sol. in 3 pts. H_2O (Rammelsberg, Pogg. **52.** 84); less sol. in H_2O than $SrBr_2+6H_2O$. (Löwig.)

Thallous bromate, $TlBrO_3$.

Sl. sol. in hot H_2O; easily sol. in HNO_3+Aq. (Oettinger.)

Easily sol. in H_2O and dil. acids. (Ditte, A. ch. (6) **21.** 145.)

Thorium bromate.

Not obtained pure.

Stannous bromate (?).

Insol. in H_2O; sol. in $HCl+Aq$.

Uranyl bromate, $4UO_3, 3Br_2O_5+16H_2O$.

Sol. in H_2O. (Rammelsberg.)

Yttrium bromate, $Y(BrO_3)_3+9H_2O$.

More easily sol. in H_2O than $Y(IO_3)_3$. Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Zinc bromate, $Zn(BrO_3)_2+6H_2O$.

Sol. in 1 pt. cold H_2O. (Rammelsberg, Pogg. **52.** 90.)

Zinc bromate ammonia, $Zn(BrO_3)_2, 2NH_3+3H_2O$.

Decomp. by H_2O and alcohol. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **52.** 90.)

*Per*bromic acid.

See **Perbromic acid.**

Bromides.

Most bromides are sol. in H_2O, many in alcohol, and some in ether.

AgBr and Hg_2Br_2 are insol. in H_2O or acids; $PbBr_2$ and TlBr are sl. sol. therein. Cu_2Br_2 is insol. in H_2O, sol. in acids.

See under each element.

Bromine, Br_2.

Crystallises at 4° with $10H_2O$.

1 pt. Br dissolves at 15° in 33 pts. H_2O. (Löwig, Pogg. **14.** 485.)

1 pt. Br dissolves at 15° in 31 pts. H_2O. (Dancer, Chem. Soc. **15.** 477.)

Solubility of Br in 100 pts. H_2O at t°.

t°	Pts. Br	t°	Pts. Br	t°	Pts. Br
5	3·600	15	3·226	25	3·167
10	3·327	20	3·208	30	3·126

(Dancer, *l.c.*)

A sat. aqueous solution of Br contains 4·05 % Br at 0°; 3·80 % Br at 3°; 3·33 % Br at 10°. (Roozeboom, R. t. c. **3.** 29, 59, 73, 84.)

Sp. gr. of Br_2+Aq containing pts. Br in 1000 pts. solution.

Pts. Br	Sp. gr.	Pts. Br	Sp. gr.
10·72	1·00901	18·74-19·06	1·01491
10·68	1·00931	19·52-20·09	1·01585
12·05	1·00995	20·89-21·55	1·01807
12·31	1·01223	31·02-31·69	1·02367

(Slessor, N. Edin. Phil. J. **7.** 287.)

Sol. in conc. HCl, HBr, conc. solutions of bromides, and in liquid SO_2. (Sestini, Zeit. Chem. **1868.** 718.)

Much more sol. in $HCl+Aq$ than in H_2O.

100 ccm. $HCl+Aq$ of 1·153 sp. gr. dissolve 36·4 g. Br at 12°.

More sol. in $SrCl_2$, and $BaCl_2+Aq$ than in H_2O. (Berthelot, C. R. **100.** 761.)

Bromine is not more sol. in $KBr+Aq$ than in H_2O (?). (Balard.)

$KBr+Aq$ containing 1 pt. KBr to 6 pts. H_2O takes up as much Br as it already contains; when this solution is heated the dissolved Br is separated. 1 pt. KBr+1 pt. H_2O takes up twice as much Br as it already contains, much heat being evolved. This solution loses Br on exposure to the air or when heated. (Löwig.)

More sol. in alcohol than in H_2O; miscible with ether, CS_2, $CHCl_3$. (Sestini, Zeit. Chem. **1868.** 718.)

Somewhat soluble in glycerine. (Pelouze.) Sol. in benzene (Mansfield); insol. in benzene (Moride, A. ch. (3) **39.** 452). Sol. in warm chloral, bromal, and iodal. (Löwig, Pogg. **14.** 485.) Sol. in SCl_2 (Solly), and SBr_2. Sol. in conc. $HC_2H_3O_2+Aq$. (Balard.) Sol. in aqueous solution of potassium, sodium, or calcium acetates. (Cahours.)

Bromine chloride, BrCl.

Sol. in H_2O, CS_2, ether, etc.

Bromine oxides.

No oxides of bromine are known in the free state. *See* hypobromous, bromic, *and* perbromic acids.

Bromiridic acid.

Ammonium bromiridate, $(NH_4)_2IrBr_6$.

Less sol. in cold H_2O than the K salt. (Birnbaum, Zeit. Chem. **1865.** 22.)

Potassium bromiridate, K_2IrBr_6.

Moderately sol. in cold, more easily in hot H_2O.

Insol. in alcohol or ether.

Sodium bromiridate.

Deliquescent. Easily sol. in H_2O, alcohol, or ether.

Bromiridous acid, $H_6Ir_2Br_{12}+6H_2O$.

Easily sol. in H_2O, alcohol, or ether. (Birnbaum, **1864**.)

Ammonium bromiridite, $(NH_4)_6Ir_2Br_{12}+H_2O$.

Difficultly sol. in H_2O. (Birnbaum.)

Potassium bromiridite, $K_6Ir_2Br_{12}+6H_2O$.

Efflorescent. Sol. in H_2O.

Silver bromiridite, $Ag_6Ir_2Br_{12}$.

Ppt. Insol. in H_2O or acids.

Sodium bromiridite, $Na_6Ir_2Br_{12}+24H_2O$.

Efflorescent. Very sol. in H_2O.

Bromocarbonatoplatin*di*amine carbonate, ${}^{CO_3}_{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2+4H_2O$.

Ppt.

Bromocarbonatoplatin*di*amine carbonate bromoplatin*di*amine nitrate, ${}^{CO_3}_{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2, 2Br_2Pt(N_2H_6)_2(NO_3)_2$.

Bromochloroplatin*di*amine chloride, ${}^{Br}_{Cl}Pt(N_2H_6)_2Cl_2$.

Very sl. sol. in H_2O. (Cleve.)

—— **chlorobromide,** ${}^{Br}_{Cl}Pt\begin{matrix}N_2H_6Cl\\N_2H_6Br\end{matrix}$(?).

Very sl. sol. in H_2O.

Bromochloroplatinic acid.

Potassium bromochloroplatinate, $2KBr, PtCl_4 = K_2PtBr_2Cl_4$.

Bromochromic acid.

Potassium bromochromate, $KCrO_3Br_2 = CrO_2(Br)OK$.

Decomp. by H_2O. (Heintze, J. pr. (2) **4.** 225.)

Bromohydroxyloplatin*di*amine bromide, ${}^{OH}_{Br}Pt(N_2H_6Br)_2$.

Very sl. sol. in H_2O. (Cleve.)

—— **chloride,** ${}^{OH}_{Br}Pt(N_2H_6Cl)_2$.

Sol. in H_2O. (Cleve.)

—— **nitrate,** ${}^{OH}_{Br}Pt(N_2H_6NO_3)_2$.

Very sl. sol. in cold, moderately sol. in hot H_2O. (Cleve.)

Bromohydroxyloplatin*monodi*amine nitrate, ${}^{Br}_{OH}Pt\begin{matrix}(NH_3)_2NO_3\\NH_3NO_3\end{matrix}+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromomercurosulphurous acid.

Ammonium bromomercurosulphite, NH_4SO_3HgBr.

Sol. in H_2O. (Barth, Z. phys. Ch. **9.** 215.)

Potassium bromomercurosulphite, KSO_3HgBr.

As above. (B.)

Bromomolybdenum bromide, $Br_4Mo_3Br_2$ = molybdenum *di*bromide, $MoBr_2$.

Insol. in H_2O or acids, or even in boiling aqua regia. Easily sol. in dilute, decomp. by conc. alkalies + Aq. (Blomstrand, J. pr. **82.** 436.)

Bromomolybdenum chloride, $Br_4Mo_3Cl_2+3H_2O$.

Insol. in acids. (Blomstrand.)

Bromomolybdenum chromate, $Br_4Mo_3CrO_4+2H_2O$.

Insol. in dil. acids. Sol. in hot conc. HCl + Aq. Insol. in alkali chromates + Aq. (Atterberg.)

Bromomolybdenum fluoride, $Br_4Mo_3F_2+3H_2O$.

Insol. in H_2O. (Atterberg.)

Bromomolybdenum hydroxide, $Br_4Mo_3(OH)_2$.

Completely sol. in alkalies if not heated over 90°. (Atterberg.)

$+2H_2O$.

$+8H_2O$.

Bromomolybdenum iodide hydroxide, $2Br_4Mo_3I_2, Br_4Mo_3(OH)_2+8H_2O$.

Precipitate. (Blomstrand, J. pr. **77.** 92.)

Bromomolybdenum molybdate, $Br_4Mo_3MoO_4$.

Precipitate. (Atterberg.)

Bromomolybdenum phosphate, $Br_4Mo_3H_4(PO_4)_2$.

Precipitate. Insol. in H_2O. (Atterberg.)

Bromomolybdenum sulphate, $Br_4Mo_3SO_4+3H_2O$.

Precipitate. Sl. sol. in boiling H_2SO_4. (Atterberg.)

Bromonitratoplatin*di*amine nitrate, ${}^{Br}_{NO_3}Pt\begin{matrix}N_2H_6NO_3\\N_2H_6NO_3\end{matrix}$.

Decomp. by H_2O. (Cleve.)

—— **sulphate,** ${}^{Br}_{NO_3}Pt(N_2H_6)_2SO_4+H_2O$.

Sl. sol. in H_2O.

Bromonitritoplatin*semidi*amine nitrite, $NO_2Br_2Pt(NH_3)_2NO_2$.

Sl. sol. in H_2O. (Blomstrand.)

Bromopalladious acid.

Barium bromopalladite.

Not deliquescent. Sol. in H_2O. (v. Bonsdorff.)

Manganese bromopalladite.

Sol. in H_2O and alcohol. (v. Bonsdorff.)

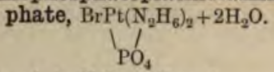
Potassium bromopalladite, K_2PdBr_4.

Easily sol. in H_2O. (Joannis, C. R. **95.** 295.)

Zinc bromopalladite.

Sol. in H_2O. (v. Bonsdorff.)

Bromophosphatoplatin*di*amine phosphate,



$BrPt(N_2H_6)_2 + 2H_2O$, with PO_4 bonded below to both (N_2H_6) groups: $\underbrace{BrPt(N_2H_6)_2}_{PO_4}+2H_2O$.

Sl. sol. in H_2O. (Cleve.)

Bromoplatinamine bromide, $Br_2Pt(NH_3Br)_2$.

Sl. sol. in H_2O. (Cleve, Sv. V. A. H. **10**, **9**. 31.)

—— **nitrite,** $Br_2Pt(NH_3NO_2)_2$.

Very sl. sol. in H_2O. (Cleve.)

Bromoplatin*di*amine bromide, $Br_2Pt(N_2H_6)_2Br_2$.

Only sl. sol. in hot H_2O. (Cleve.)

—— **chloride,** $Br_2Pt(N_2H_6)_2Cl_2$.

Very sl. sol. in H_2O. (Cleve.)

—— ***di*chromate,** $Br_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in H_2O.

—— **nitrate,** $Br_2Pt(N_2H_6NO_3)_2$.

Sl. sol. in cold, rather easily sol. in hot H_2O. (Cleve.)

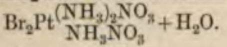
—— **phosphate,** $Br_2Pt[N_2H_6PO_2(OH)_2]_2 + 2H_2O$.

Rather easily sol. in hot H_2O. (Cleve.)

—— **sulphate,** $Br_2Pt(N_2H_6)_2SO_4$.

Very sl. sol. in H_2O.

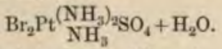
Bromoplatin*monodi*amine nitrate,



$Br_2Pt\begin{matrix}(NH_3)_2NO_3\\NH_3NO_3\end{matrix}+H_2O$.

Easily sol. in H_2O.

—— **sulphate,**



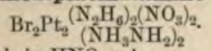
$Br_2Pt\begin{matrix}(NH_3)_2\\NH_3\end{matrix}SO_4+H_2O$.

Moderately sol. in H_2O. (Cleve.)

Bromoplatin*semidi*amine bromide, $Br_3Pt(NH_3)_2Br$.

Sl. sol. in cold H_2O. (Cleve.)

Bromo*di*platin*di*amine anhydronitrate,



$Br_2Pt_2\begin{matrix}(N_2H_6)_2(NO_3)_2\\(NH_3NH_2)_2\end{matrix}$.

Sol. in HNO_3 + Aq.

—— **chloride,** $Br_2Pt_2(N_2H_6)_4Cl_4$.

Ppt. (Cleve.)

—— **nitrate,** $Br_2Pt_2(N_2H_6)_4(NO_3)_4 + 2H_2O$.

Moderately sol. in hot H_2O.

—— **sulphate,** $Br_2Pt_2(N_2H_6)_4(SO_4)_2 + 2H_2O$.

Ppt. (Cleve.)

Bromoplatinic acid, $H_2PtBr_6 + 9H_2O$.

Very deliquescent, and sol. in H_2O, alcohol, ether, chloroform, or acetic acid. (Topsoë, J. B. **1868**. 273.)

Ammonium bromoplatinate, $(NH_4)_2PtBr_6$.

Sol. in 200 pts. H_2O at 15° (Topsoë.)

100 pts. $(NH_4)_2PtBr_6$ + Aq sat. at 20° contain 0·59 pt. dry salt. (Halberstadt, B. **17**. 2965.)

Barium bromoplatinate, $BaPtBr_6 + 10H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Calcium bromoplatinate, $CaPtBr_6 + 12H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Cobalt bromoplatinate, $CoPtBr_6 + 12H_2O$.

Deliquescent.

Copper bromoplatinate, $CuPtBr_6 + 8H_2O$.

Very deliquescent; sol. in H_2O.

Lead bromoplatinate, $PbPtBr_6$.

Easily sol. in H_2O, but decomp. by large amount.

Magnesium bromoplatinate, $MgPtBr_6 + 12H_2O$.

Not deliquescent.

Manganese bromoplatinate, $MnPtBr_6 + 6H_2O$.

Sol. in H_2O.

$+12H_2O$. Sol. in H_2O.

Nickel bromoplatinate, $NiPtBr_6 + 12H_2O$.

Deliquescent.

Potassium bromoplatinate, K_2PtBr_6.

Sl. sol. in H_2O. Insol. in alcohol. (v. Bonsdorff, Pogg. **19**. 344.)

Sol. in 10 pts. boiling H_2O. (Pitkin, C. N. **41**. 218.)

100 pts. K_2PtBr_6 + Aq sat. at 20° contain 2·02 pts. dry salt. (Halberstadt, B. **17**. 2962.)

Sodium bromoplatinate, $Na_2PtBr_6 + 6H_2O$.

Easily sol. in H_2O and alcohol.

Strontium bromoplatinate, $SrPtBr_6 + 10H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Zinc bromoplatinate, $ZnPtBr_6 + 12H_2O$.

Sol. in H_2O.

Bromoplatinocyanhydric acid, $H_2Pt(CN)_4Br_2$.

See **Perbromoplatinocyanhydric acid.**

Potassium bromoplatinocyanide, $5K_2Pt(CN)_4$, $K_2Pt(CN)_4Br_2 + 18H_2O$.

Sol. in H_2O.

Bromopurpureochromium bromide, $BrCr(NH_3)_5Br_2$.

Less sol. in H_2O than chloropurpureochromium chloride. (Jörgensen, J. pr. (2) **25**. 83.)

—— **bromoplatinate,** $BrCr(NH_3)_5\ PtBr_6$.

(Jörgensen, *l.c.*)

—— **chloride,** $BrCr(NH_3)_5Cl_2$.

More sol. in H_2O than the bromide. (Jörgensen, *l.c.*)

—— **chromate,** $BrCr(NH_3)_5CrO_4$.

Precipitate. (Jörgensen, *l.c.*)

—— **nitrate,** $BrCr(NH_3)_5(NO_3)_2$.

More sol. than bromide and less than chloride. (Jörgensen, *l.c.*)

Bromopurpureocobaltic bromide, $CoBr(NH_3)_5Br_2$.

Sol. in 530 pts. H_2O at 16°. Insol. in alcohol, NH_4Br, KBr, or HBr + Aq. More sol. in hot H_2O containing a little HBr. (Jörgensen, J. pr. (2) **19**. 49.)

Bromopurpureocobaltic mercuric bromide, $CoBr(NH_3)_5Br_2$, $3HgBr_2$.

More sol. in H_2O than the corresponding $HgCl_2$ salt. (J.)

—— **bromoplatinate.**

Very sl. sol. in cold H_2O. (J.)

—— **chloride,** $CoBr(NH_3)_5Cl_2$.

Difficultly sol. in cold H_2O, but much more easily than the bromide. Insol. in dil. HCl+Aq, and in alcohol.

—— **mercuric chloride,** $CoBr(NH_3)_5Cl_2$, $3HgCl_2$.

Sl. sol. in H_2O.

—— **chloroplatinate.**

Nearly or quite insol. in H_2O. (J.)

—— **chromate,** $CoBr(NH_3)_5CrO_4$.

Nearly insol. in H_2O.

—— **dithionate,** $CoBr(NH_3)_5S_2O_6$.

Nearly insol. in H_2O.

—— **fluosilicate,** $CoBr(NH_3)_5SiF_6$.

Very sl. sol. in cold H_2O ; insol. in alcohol.

—— **nitrate,** $CoBr(NH_3)_5(NO_3)_2$.

More sol. in H_2O than the bromide, but less than the chloride. Wholly insol. in dil. HNO_3 +Aq or alcohol.

—— **oxalate,** $CoBr(NH_3)_5C_2O_4$.

Nearly insol. in H_2O.

—— **sulphate,** $CoBr(NH_3)_5SO_4$.

Can be crystallised from very dil. H_2SO_4+Aq. Insol. in alcohol.

+$6H_2O$. Efflorescent.

Bromopurpureorhodium bromide, $BrRh(NH_3)_5Br_2$.

Much less easily sol. in H_2O than the chlorochloride. Insol. in dil. HBr+Aq and alcohol. (Jörgensen, J. pr. (2) **27**. 433.)

—— **bromoplatinate,** $BrRh(NH_3)_5PtBr_6$.

Almost insol. in H_2O.

—— **fluosilicate,** $BrRh(NH_3)_5SiF_6$.

Sl. sol. in H_2O. Sol. in boiling NaOH+Aq as roseo salt.

—— **nitrate,** $BrRh(NH_3)_5(NO_3)_2$.

Sl. sol. in H_2O, but much more sol. than the bromide.

Bromoselenic acid.

Ammonium bromoselenate, $(NH_4)_2SeBr_6$.

Sol. in H_2O with decomp. (Muthmann and Schäfer, B. **26**. 1008.)

Potassium bromoselenate, K_2SeBr_6.

As NH_4 salt. (M. and S.)

Bromo*pyro*selenious acid.

Potassium bromo*pyro*selenite, KBr, $2SeO_2+2H_2O$.

Sol. in H_2O. (Muthmann and Schäfer, B. **26**. 1008.)

Bromostannic acid, $H_2SnBr_6+8H_2O$.

Very deliquescent. Sol. in H_2O. (Seubert, B. **20**. 794.)

Ammonium bromostannate, $(NH_4)_2SnBr_6$.

Very deliquescent, and sol. in H_2O. (Raymann and Preis, A. **223**. 323.)

Cæsium bromostannate.

Sol. in H_2O. (Raymann and Preis.)

Calcium bromostannate, $CaSnBr_6+6H_2O$.

Very deliquescent. Sol. in H_2O. (Raymann and Preis.)

Cobalt bromostannate, $CoSnBr_6+10H_2O$.

Deliquescent. (Raymann and Preis.)

Ferrous bromostannate, $FeSnBr_6+6H_2O$.

Deliquescent. (Raymann and Preis.)

Lithium bromostannate, $Li_2SnBr_6+6H_2O$.

Extremely deliquescent. (Leteur, C. R. **113**. 541.)

Magnesium bromostannate, $MgSnBr_6+10H_2O$.

Deliquescent. (Raymann and Preis.)

Manganous bromostannate, $MnSnBr_6+6H_2O$.

Deliquescent. (Raymann and Preis.)

Nickel bromostannate, $NiSnBr_6+8H_2O$.

Deliquescent. (Raymann and Preis.)

Potassium bromostannate, K_2SnBr_6.

Sol. in H_2O. (Topsoë.)

Rubidium bromostannate.

Sol. in H_2O. (Raymann and Preis.)

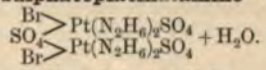
Sodium bromostannate, $Na_2SnBr_6+6H_2O$.

Not deliquescent, but extremely sol. in H_2O. (Seubert, B. **20**. 796.)

Strontium bromostannate, $SrSnBr_6+6H_2O$.

Very hygroscopic, and sol. in H_2O. (Raymann and Preis.)

Bromosulphatoplatin*di*amine sulphate,



$$\begin{array}{l}\mathrm{Br}\\ \mathrm{SO_4}\\ \mathrm{Br}\end{array}\!\!\begin{array}{l}>\mathrm{Pt(N_2H_6)_2SO_4}\\ >\mathrm{Pt(N_2H_6)_2SO_4}\end{array}+\mathrm{H_2O}.$$

Rather easily sol. in hot H_2O.

Bromotelluric acid.

Cæsium bromotellurate, Cs_2TeBr_6.

Decomp. by H_2O.

100 pts. HBr+Aq (sp. gr. 1·49) dissolve 0·02 pt. at 22°.

100 pts. HBr+Aq (sp. gr. 1·08) dissolve 0·13 pt. at 22°.

Insol. in alcohol. (Wheeler, Sill. Am. J. **145**. 267.)

Potassium bromotellurate, $K_2TeBr_6+3H_2O$.

Sol. in little, decomp. by much H_2O. (v. Hauer.)

Contains $2H_2O$. (Wheeler, Sill. Am. J. **145**. 267.)

Efflorescent.

100 pts. HBr+Aq (sp. gr. 1·49) di 6·57 pts. at 22°.

100 pts. $HBr+Aq$ (sp. gr. 1·08) dissolve 62·90 pts. at 22°.

Anhydrous. Stable on air. (Wheeler.)

Rubidium bromotellurate, Rb_2TeBr_6.

Sol. in a little hot H_2O, but H_2TeO_3 separates on cooling.

100 pts. $HBr+Aq$ (sp. gr. 1·49) dissolve 0·25 pt. at 22°.

100 pts. $HBr+Aq$ (sp. gr. 1·08) dissolve 3·88 pts. at 22°. (Wheeler.)

Bromotetramine chromium bromide, $CrBr(NH_3)_4Br_2+H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **chloride**, $CrBr(NH_3)_4Cl_2+H_2O$.

Sol. in H_2O. (Cleve.)

—— **sulphate**, $CrBr(NH_3)_4SO_4+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromotetramine cobaltic sulphate, $BrCo(NH_3)_4SO_4$, or $Br_2Co_2(NH_3)_8(SO_4)_2$.

Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2652.)

Cadmium, Cd.

Not attacked by H_2O. Sol. in HCl, or dil. H_2SO_4+Aq, but more easily in HNO_3+Aq. Sol. in $HC_2H_3O_2+Aq$.

Not attacked by sugar solution. (Klein and Berg, C. R. **102.** 1170.)

Cadmium arsenide, Cd_3As.

(Descamps, C. R. **86.** 1022.)

Cadmium bromide, $CdBr_2$.

Deliquescent. Very sol. in H_2O.

Sp. gr. of $CdBr_2+Aq$ at 19·5° containing:

5	10	15	20	25 % $CdBr_2$,
1·043	1·090	1·141	1·199	1·260
30	35	40	45	50 % $CdBr_2$.
1·326	1·400	1·481	1·578	1·680

(Kremers, calculated by Gerlach, Z. anal. **8.** 280.)

Sol. in $HCl+Aq$, $HC_2H_3O_2$, alcohol, or ether. (Berthemot, A. ch. **44.** 387.)

Sol. in 0·94 pt. H_2O, 3·4 pts. abs. alcohol, 250 pts. ether, and 16 pts. alcohol-ether (1:1). (Eder, Dingl. **221.** 89.)

Anhydrous $CdBr_2$ is sol. in acetone. (Krug and M'Elroy.)

$+4H_2O$. Efflorescent. (Rammelsberg, Pogg. **55.** 241.)

Cadmium hydrogen bromide.

Decomp. by H_2O. (Berthelot, C. R. **91.** 1024.)

Cadmium cæsium bromide, $CdBr_2$, CsBr.

Easily sol. in H_2O. (Wells and Walden, Z. anorg. **5.** 270.)

$CdBr_2$, 2CsBr. Decomp. by H_2O into above comp. (W. and W.)

$CdBr_2$, 3CsBr. Decomp. by H_2O into $CdBr_2$, CsBr. (W. and W.)

Cadmium potassium bromide, $CdBr_2$, $KBr+\frac{1}{2}H_2O$.

Sol. in 0·79 pt. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221.** 89.)

$CdBr_2$, 4KBr. Sol. in 1·40 pts. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221.** 89.)

Cadmium sodium bromide, $CdBr_2$, $NaBr+2\frac{1}{2}H_2O$.

Sol. at 15° in 1·04 pts. H_2O, 3·7 pts. abs. alcohol, and 190 pts. ether (sp. gr. 0·729). (Eder, Dingl. **221.** 89.)

Cadmium bromide ammonia, $CdBr_2$, $2NH_3$.

Can be crystallised out of warm NH_4OH+Aq. (Croft, Phil. Mag. **21.** 356.)

$CdBr_2$, $4NH_3$. Decomp. by H_2O. (Croft.)

Cadmium chloride, $CdCl_2$.

Sol. at	20°	40°	60°	80°	100°
in	0·71	0·72	0·72	0·70	0·67 pts. H_2O.

Sp. gr. of $CdCl_2+Aq$ containing pts. $CdCl_2$ to 100 pts. H_2O.

13	26·9	41 pts. $CdCl_2$,
1·1068	1·2106	1·3100
55·8	72·5	114·2 pts. $CdCl_2$.
1·4060	1·5060	1·7266

(Kremers, Pogg. **103.** 57.)

$+2H_2O$. Easily sol. in H_2O; insol. in $HCl+Aq$. (John.)

Readily sol. in alcohol.

100 pts. absolute methyl alcohol dissolve 1·71 pts. $CdCl_2$ at 15·5°.

100 pts. absolute ethyl alcohol dissolve 1·52 pts. $CdCl_2$ at 15·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Somewhat sol. in acetone. (Krug and M'Elroy.)

Cadmium hydrogen chloride, $CdCl_2$, $2HCl+7H_2O$.

Decomp. on air. (Berthelot, C. R. **91.** 1024.)

Cadmium cæsium chloride, $CdCl_2$, 2CsCl.

Easily sol. in H_2O and dil. $HCl+Aq$; insol. in conc. $HCl+Aq$. (Godeffroy, B. **8.** 9.)

Nearly insol. in $CsCl+Aq$. (Wells and Walden, Z. anorg. **5.** 266.)

$CdCl_2$, CsCl. Sl. sol. in H_2O; nearly insol. in $CdCl_2+Aq$. (Wells and Walden.)

Cadmium calcium chloride, $2CdCl_2$, $CaCl_2+7H_2O$.

Rather deliquescent and very sol. in H_2O. When ignited is only sl. sol. in H_2O with evolution of heat. (v. Hauer, J. pr. **63.** 432.)

$CdCl_2$, $2CaCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium cobaltous chloride, $2CdCl_2$, $CoCl_2+12H_2O$.

Deliquescent. Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium cupric chloride, $CdCl_2$, $CuCl_2+4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium ferrous chloride, $2CdCl_2$, $FeCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17**. 331.)

Cadmium lithium chloride, $CdCl_2$, $LiCl+3\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by solution in H_2O, but not in alcohol. (Chassevant, A. ch. (6) **30**. 39.)

Cadmium magnesium chloride, $2CdCl_2$, $MgCl_2+12H_2O$.

Deliquescent in moist, stable in dry air. Easily sol. in H_2O with absorption of heat. Much more sol. in hot than in cold H_2O. (v. Hauer.)

$CdCl_2$, $2MgCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium manganese chloride, $2CdCl_2$, $MnCl_2+12H_2O$.

Deliquescent in moist, efflorescent in dry air. Sol. in H_2O. (v. Hauer.)

Cadmium nickel chloride, $CdCl_2$, $2NiCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20**. 40.)

$2CdCl_2$, $NiCl_2+12H_2O$. Sol. in H_2O. (v. Hauer.)

Cadmium potassium chloride, $CdCl_2$, $KCl+\frac{1}{2}H_2O$.

Sol. in H_2O without decomp. (v. Hauer.)

$CdCl_2$, $4KCl$. More sol. in H_2O than $CdCl_2$, KCl. (v. Hauer.)

$CdCl_2$, $2KCl$. 100 pts. H_2O at 15·5° dissolve 33·45 pts. Sl. sol. in alcohol. (Croft, Phil. Mag. (3) **21**. 356.)

Cadmium rubidium chloride, $CdCl_2$, $2RbCl$.

Sol. in H_2O and $HCl+Aq$. (Godeffroy, B. **8**. 9.)

$CdCl_2$, $RbCl+\frac{1}{2}H_2O$. (Godeffroy, Arch. Pharm. (3) **12**. 47.)

Cadmium sodium chloride, $CdCl_2$, $2NaCl+3H_2O$.

Sol. in 1·4 pts. H_2O at 16°.

Sl. sol. in alcohol or wood alcohol. (Croft.)

Cadmium strontium chloride, $2CdCl_2$, $SrCl_2+7H_2O$.

Sol. in H_2O. (v. Hauer.)

Cadmium chloride ammonia, $CdCl_2$, $2NH_3$.

Nearly insol. in H_2O. (v. Hauer.)

$CdCl_2$, $2NH_3+\frac{1}{2}H_2O$.

$CdCl_2$, $6NH_3+\frac{1}{2}H_2O$.

$CdCl_2$, $2NH_3$. (André, C. R. **104**. 908.)

$CdCl_2$, $6NH_3$. Difficultly sol. in cold H_2O. (Schüler, A. **87**. 34.)

Cadmium chloride hydroxylamine, $CdCl_2$, $2NH_2OH$.

Sl. sol. in cold, somewhat more in warm H_2O. Very sol. in hydroxylamine + Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) **3**. 116.)

Cadmium fluoride, CdF_2.

Difficultly sol. in H_2O. Easily sol. in $HF+Aq$. (Berzelius, Pogg. **1**. 26.)

Very sol. in H_2O; insol. in 95 % alcohol; sol. in HCl, H_2SO_4, or HNO_3+Aq with evolution of HF. (Poulenc, C. R. **116**. 582.)

Cadmium columbium fluoride.

See **Fluocolumbate, cadmium.**

Cadmium molybdenyl fluoride.

See **Fluoxymolybdate, cadmium.**

Cadmium stannic fluoride.

See **Fluostannate, cadmium.**

Cadmium zirconium fluoride.

See **Fluozirconate, cadmium.**

Cadmous hydroxide, CdOH.

Insol. in H_2O. Decomp. by acids into cadmic salt. (Morse and Jones, Am. Ch. J. **12**. 488.)

Cadmium hydroxide, CdO_2H_2.

Insol. in H_2O; sol. in acids; very sol. in NH_4OH+Aq; insol. in KOH, NaOH, Na_2CO_3, K_2CO_3, and $(NH_4)_2CO_3+Aq$.

Easily sol. in $(NH_4)_2SO_4$, NH_4Cl, NH_4NO_3, and NH_4 succinate + Aq. (Wittstein.)

Insol. in ethyl, and methyl amine + Aq. (Wurtz.)

Very sl. sol. in HCN + Aq even when freshly pptd. (Schüler, A. **87**. 48.)

Not pptd. in presence of Na citrate (Spiller), and many non-volatile organic substances. (Rose.)

Cadmium iodide, CdI_2.

Sol. in 1·13 pts. H_2O at 15°. (Eder, Dingl. **221**. 89.)

Sol. at	20°	40°	60°	80°	100°
in	1·08	1·00	0·93	0·86	0·75 pts. H_2O.

(Kremers, Pogg. **103**. 57.)

Sp. gr. of CdI_2+Aq containing pts. CdI_2 to 100 pts. H_2O.

21·4	43·7	88·5 pts. CdI_2.
1·1681	1·328	1·6139

(Kremers, Pogg. **111**. 60.)

Sp. gr. of CdI_2+Aq at 19·5° containing:

5	10	15	20	25 % CdI_2,
1·044	1·088	1·138	1·194	1·253
30	35	40	45	50 % CdI_2,
1·319	1·395	1·476	1·575	1·690

(Kremers, calculated by Gerlach, Z. anal. **8**. 285.)

Sol. in sat. $HI+Aq$.

Sol. in warm NH_4OH+Aq.

Sol. in 15 pts. alcohol. (Vogel, N. Rep. Pharm. **22**. 398.)

Sol. in 0·98 pt. abs. alcohol. (Eder, Dingl. **221**. 89.)

Sol. in 3·6 pts. ether. (Eder, *l.c.*)

Sol. in 2·9 pts. alcohol-ether (1 : 1). (Eder, *l.c.*)

Sol. in 5·2 mols. methyl, 7 mols. ethyl, and 9·8 mols. propyl alcohol at 20°. (Timofejew, C. R. **112**. 1224.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3**. 343.)

Cadmium cæsium iodide, CdI_2, $CsI+H_2O$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5**. 271.)

CdI_2, 2CsI. As above.

CdI_2, 3CsI. Decomp. by H_2O into the above salt.

Cadmium mercuric iodide.

Very sol. in H_2O. (Berthemot, J. Pharm. **14**. 613.)

CdI_2, $3HgI_2$. Sol. in H_2O. Can be recrystallised in alcohol. (Clarke and Kebler, Am. Ch. J. **5**. 235.)

Cadmium potassium iodide, CdI_2, $KI+H_2O$.

Sol. in 0·94 pt. H_2O at 15°. (Eder, Dingl. **221**. 89.)

CdI_2, $2KI+2H_2O$. Deliquescent. Extremely sol. in H_2O. Sol. at 15° in 0·73 pt. H_2O. Sl. sol. in alcohol and wood spirit, but less than CdI_2. (Croft.)

Sol. at 15° in 1·4 pts. absolute alcohol, 24·5 pts. ether (0·729 sp. gr.), and 4·5 pts. alcohol-ether (1 : 1). (Eder, *l.c.*)

Cadmium sodium iodide, CdI_2, $2NaI+6H_2O$.

Deliquescent. (Croft.)

Sol. at 15° in 0·63 pt. H_2O, 0·86 pt. abs. alcohol, and 10·1 pts. ether (sp. gr. 0·729). (Eder, Dingl. **221**. 89.)

Cadmium strontium iodide, CdI_2, SrI_2+8H_2O.

Deliquesces in moist, effloresces in dry air; sol. in H_2O. (Croft.)

Cadmium iodide ammonia, CdI_2, $2NH_3$.

Decomp. by H_2O. (Rammelsberg.)

CdI_2, $6NH_3$. Decomp. by H_2O; sol. in warm, less sol. in cold NH_4OH+Aq. (Rammelsberg.)

Cadmous oxide, Cd_2O.

Properties as cadmous hydroxide. (Morse and Jones.)

Cadmium oxide, CdO.

Insol. in H_2O. Sol. in acids. Sol. in $NH_4OH + Aq$. Insol. in $(NH_4)_2CO_3 + Aq$. Easily sol. in NH_4Cl+Aq, less in NH_4NO_3+Aq. (Brett, **1837**.)

Insol. in KOH, NaOH, K_2CO_3, and Na_2CO_3+Aq.

See also **Cadmium hydroxide.**

Solubility in (calcium sucrate + sugar) + Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 0·22 g. CdO.

1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·48 g. CdO.

(Bodenbender, J. B. **1865**. 600.)

Cadmium *per*oxide, Cd_5O_8 or Cd_3O_5 (?).

(Haas.)

CdO_2, $Cd(OH)_2$. (Kouriloff, A. ch. (6) **23**. 431.)

Cadmium oxybromide, $CdBr_2$, CdO.

(de Schulten.)

Cadmium oxychloride, $CdCl_2$, $CdO+H_2O$.

Sl. sol. in hot H_2O. (Habermann, M. Ch. **5**. 432.)

Cadmium phosphide, Cd_3P_2.

Sol. in $HCl+Aq$ with evolution of PH_3. (Stromeyer.)

Cd_2P. Sol. in conc. $HCl+Aq$. (Emmerling, B. **12**. 152.)

Easily decomp. by acids. (Kulisch, A. **231**. 327.)

CdP_2. Decomp. by boiling conc. $HCl+Aq$. (Renault, C. R. **76**. 283.)

Cadmium selenide, CdSe.

Sol. in $HCl+Aq$. (Uelsmann, A. **116**. 122.)

Cadmium sulphide, CdS.

Insol. in H_2O. Difficultly sol. in hot dil. $HCl+Aq$. Easily sol. in cold conc. $HCl+Aq$. (Stromeyer.) Sol. in HNO_3+Aq (Meissner), and boiling dil. H_2SO_4+Aq (1 : 6). (A. W. Hoffmann, A. **115**. 286.) Very sl. sol. in NH_4OH+Aq. (Wackenroder, Repert. **46**. 226.) Insol. in KOH, or $(NH_4)_2S+Aq$.

Much more sol. in $(NH_4)_2S+Aq$ than usually supposed. (Ditte, C. R. **85**. 402.) Solubility increases by warming, and at 68° is twice that at ordinary temperatures. A sat. solution of $(NH_4)_2S$ dissolves about 2 g. CdS to a litre. Alkali sulphides dissolve much less. (Ditte.)

Fresenius (Z. anal. **20**. 236) could not confirm the above. According to Fresenius, CdS is not appreciably sol. in $(NH_4)_2S+Aq$.

Insol. in Na_2SO_3 or $KCN+Aq$. (Fresenius.)

Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, -stannates + Aq. (Storch, B. **16**. 2015.)

Min. *Greenockite.* Sol. in $HCl+Aq$.

Colloidal.—Solution of 4 g. colloidal CdS in a litre H_2O remains transparent several days. If it contains 11 g. CdS in a litre, it is completely coagulated in 24 hours. Solutions of salts of the following concentration cause an immediate coagulation in an aqueous solution of CdS containing 3·62 g. in a litre.

KCl	1 : 1615
KBr	1 : 727
KI	1 : 57
KCN	1 : 166
$KClO_3$	1 : 1666
KNO_3	1 : 1000
$K_2S_2O_6$	1 : 5000
K_2SO_4	1 : 833
$K_3Fe(CN)_6$	1 : 166
$K_4Fe(CN)_6$	< 1 : 100
K_2CrO_4	1 : 400
$K_2Cr_2O_7$	1 : 3571
NaCl	1 : 2666
$Na_2S_2O_3$	1 : 98
$NaHCO_3$	1 : 333
Na_2CO_3	1 : 166
Na_2HPO_4	1 : 202
$NaC_2H_3O_2$	1 : 2451
Na benzoate	1 : 10,000
$(NH_4)_2C_2O_4$	1 : 588
$BaCl_2$	1 : 11,764
$Ba(NO_3)_2$	1 : 8032
BaS_2O_6	1 : 5617
$MgSO_4$	1 : 41,666
$MnSO_4$	1 : 22,222

$CdSO_4$	1 : 250,000
$Cd(NO_3)_2$	1 : 285,714
$Pb(ClO_3)_2$	1 : 209
$Pb(C_2H_3O_2)_2$	1 : 147,058
$Hg(CN)_2$	<1 : 20
$Al_2(SO_4)_3$	1 : 232,558
Alum	1 : 192,377
Chrome alum	1 : 42,555
HCl	1 : 4807
H_2SO_4	1 : 8000
$HC_2H_3O_2$	1 : 15
$H_2C_2O_4$	1 : 23,255
Succinic acid	<1 : 100
Tartaric acid	1 : 333

(Prost, Belg. Acad. Bull. (3) **14.** 312 ; J. B. **1887.** 537.)

Cadmium *penta*sulphide, CdS_5.

Insol. in H_2O. (Schiff, A. **115.** 74.)

Mixture of CdS and S. (Follenius, Z. anal. **13.** 412.)

Cadmium sodium sulphide, 3CdS, Na_2S.

Decomp. by H_2O. (Schneider, J. pr. (2) **8.** 29.)

Cadmium telluride, CdTe.

(Fabre, C. R. **105.** 673.)

Cadmic acid.

Potassium cadmate.

Insol. in H_2O, but gradually decomp. when in contact therewith. (Meunier, C. R. **63.** 330.)

Cæsium, Cs.

Decomp. H_2O with great violence. (Setterberg, A. **211.** 100.)

Cæsium *tri*bromide, $CsBr_3$.

Sol. in H_2O ; decomp. by alcohols. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*bromide, $CsBr_5$.

Very unstable. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Cæsium copper bromide, CsBr, $CuBr_2$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5.** 304.)

2CsBr, $CuBr_2$. (W. and W.)

Cæsium lead bromide, CsBr, $2PbBr_2$.

Nearly stable in aqueous solution. (Walden, Sill. Am. J. **145.** 127.)

CsBr, $PbBr_2$. Decomp. by H_2O. (Walden.)

4CsBr, $PbBr_2$. As above.

Cæsium magnesium bromide, CsBr, $MgBr_2 + 6H_2O$.

Sol. in H_2O. (Wheeler and Campbell, Z. anorg. **5.** 275.)

Cæsium mercuric bromide, CsBr, $2HgBr_2$.

Not decomp. by H_2O. 100 pts. solution sat. at 16° contain 0·807 pt. CsBr, $2HgBr_2$. Sl. sol. in hot strong alcohol, from which CsBr, $HgBr_2$ separates on cooling. (Wells, Sill. Am. J. **144.** 221.)

CsBr, $HgBr_2$. Decomp. by H_2O into above salt. Sol. in alcohol without decomp. (Wells.)

2CsBr, $HgBr_2$. Decomp. by H_2O into CsBr, $2HgBr_2$.

3CsBr, $HgBr_2$. As above.

Cæsium tellurium bromide.

See **Bromotellurate, cæsium.**

Cæsium stannic bromide.

See **Bromostannate, cæsium.**

Cæsium zinc bromide, 3CsBr, $ZnBr_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

2CsBr, $ZnBr_2$. As above.

Cæsium bromochloride, $CsBr_2Cl$.

Properties as $CsBr_3$. (Wells.)

$CsBrCl_2$. As above. (Wells.)

Cæsium mercuric bromochloride, $Cs_3HgCl_3Br_2$.

Decomp. by H_2O finally to $HgBr_2$. (Wells, Sill. Am. J. **144.** 121.)

$Cs_2HgCl_2Br_2$. As above.

$CsHgClBr_2$. As above.

$CsHg_2ClBr_4$. As above.

$CsHg_5ClBr_{10}$. As above.

Cæsium bromochloroiodide, CsBrClI.

More sol. in H_2O than in alcohol. Not decomp. at once by ether. (Wells.)

Cæsium bromoiodide, $CsBrI_2$.

Decomp. by H_2O. Sol. in alcohol. Decomp. by ether with residue of CsBr. (Wells, Sill. Am. J. **143.** 17.)

$CsBr_2I$. More sol. in H_2O than in alcohol. Not decomp. by ether.

$CsBr_2I$ + Aq sat. at 20° contains about 4·45 % $CsBr_2I$. (Wells.)

Cæsium mercuric bromoiodide, $Cs_3HgBr_3I_2$.

(Wells, Sill. Am. J. **144.** 221.)

$Cs_2HgBr_2I_2$. (Wells.)

$CsHgBrI_2$. (Wells.)

Cæsium chloride, CsCl.

Very deliquescent ; sol. in H_2O and alcohol.

Cæsium cuprous chloride, CsCl, Cu_2Cl_2.

Decomp. by H_2O into $CuCl_2$, CsCl. (Wells, Z. anorg. **5.** 306.)

3CsCl, Cu_2Cl_2. (Wells.)

6CsCl, Cu_2Cl_2. (Wells.)

Cæsium cupric chloride, 2CsCl, $CuCl_2$.

Easily sol. in H_2O and dil. HCl + Aq ; insol. in conc. HCl + Aq. (Godeffroy, B. **8.** 9.)

Sol. in small amount H_2O without decomp. (Wells and Dupee, Z. anorg. **5.** 300.)

$+ 2H_2O$. Efflorescent. (W. and D.)

3CsCl, $2CuCl_2 + 2H_2O$.

CsCl,$CuCl_2$. Sol. in H_2O without decomp. (W. and D.)

Cæsium ferric chloride, 3CsCl, $FeCl_3$.

Easily sol. in H_2O and dil. HCl + Aq. (Godeffroy, B. **8.** 9.)

Cæsium lead chloride, CsCl, $2PbCl_2$.

Nearly stable in aqueous solution. (Campbell, Sill. Am. J. **145.** 126.)

CsCl, $PbCl_2$. Decomp. by H_2O. (Campbell.)

4CsCl, $PbCl_2$. As above. (Campbell.)

Cæsium lead *tetra*chloride.
See **Chloroplumbate, cæsium.**

Cæsium magnesium chloride, CsCl, $MgCl_2+6H_2O$.
Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

Cæsium manganous chloride, CsCl, $MnCl_2+2H_2O$.
Not deliquescent; sol. in H_2O. (Saunders, Am. Ch. J. **14.** 143.)
2CsCl, $MnCl_2$. (Godeffroy.)
$+2\frac{1}{2}H_2O$. (Godeffroy.)
$+3H_2O$. Sol. in H_2O. Conc. HCl+Aq precipitates anhydrous salt from aqueous solution. (Godeffroy, B. **8.** 9.)
The only salt which exists contains $2H_2O$. (Saunders, Am. Ch. J. **14.** 143.)

Cæsium mercuric chloride, CsCl, $HgCl_2$.
100 pts. solution sat. at 17° contain 1·406 pts. $CsHgCl_3$. Not decomp. by H_2O. Insol. in absolute alcohol, but sol. on diluting with $\frac{1}{3}$ vol. H_2O. (Wells, Sill. Am. J. **144.** 221.)
2CsCl, $HgCl_2$. Easily sol. in H_2O and dil. HCl+Aq; insol. in conc. HCl+Aq. (Godeffroy.)
3CsCl, $HgCl_2$. Decomp. by H_2O; on recrystallising from H_2O, CsCl,$HgCl_2$ is finally formed. (Wells, Sill. Am. J. **144.** 221.)
CsCl, $5HgCl_2$. Decomp. by H_2O. (Wells.)

Cæsium nickel chloride, 2CsCl, $NiCl_2$.
As the corresponding Cu salt.

Cæsium silver chloride, 2CsCl, AgCl.
Easily decomp. by H_2O. (Wells and Wheeler, Sill. Am. J. **144.** 155.)

Cæsium tellurium chloride.
See **Chlorotellurate, cæsium.**

Cæsium thallic chloride, 3CsCl, $TlCl_3+2H_2O$.
Sol. in 36·4 pts. H_2O at 17° and 3 pts. at 100°. (Godeffroy, Zeitsch. d. allgem. österr. Apothekerv. **1880.** No. 9.)

Cæsium stannic chloride.
See **Chlorostannate, cæsium.**

Cæsium zinc chloride, 3CsCl, $ZnCl_2$.
Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)
2CsCl, $ZnCl_2$. Easily sol. in H_2O and dil. HCl+Aq. Insol. in conc. HCl+Aq. (Godeffroy.)

Cæsium chloroiodide, $CsCl_2I$.
Properties as CsBrClI. (Wells.)
$CsCl_4I$. Sl. sol. in H_2O, from which it can be recrystallised without decomp. (Wells and Wheeler.)

Cæsium mercuric chloroiodide, $Cs_2HgCl_2I_2$.
Decomp. instantly by H_2O to HgI_2. (Wells.)

Cæsium hydroxide, CsOH.
Very deliquescent, and sol. in H_2O. Sol. in alcohol.

Cæsium iodide, CsI.
Sol. in H_2O.

Cæsium *tri*iodide, CsI_3.
1 ccm. sat. CsI+Aq dissolves 0·0097 g. CsI_3, and sp. gr. of solution is 1·154. Only sl. decomp. by solution in H_2O. Much more sol. in alcohol than in H_2O. Not immediately decomp. by ether. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*iodide, CsI_5.

Cæsium lead iodide, $CsPbI_3$.
Sl. sol. in hot CsI+Aq. (Wheeler, Sill. Am. J. **145.** 129.)

Cæsium mercuric iodide, CsI, $2HgI_2$.
Decomp. by H_2O finally into HgI_2. (Wells, Sill. Am. J. **144.** 221.)
2CsI, $3HgI_2$. Decomp. by H_2O finally into HgI_2.
CsI, HgI_2. As above.
2CsI, HgI_2. Decomp. by H_2O; insol. in alcohol.
3CsI, HgI_2. As above.

Cæsium silver iodide, CsI, AgI.
(Penfield, Z. anorg. **1.** 100.)

Cæsium tellurium iodide.
See **Iodotellurate, cæsium.**

Cæsium zinc iodide, 3CsI, ZnI_2.
Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)
2CsI, ZnI_2. As above.

Calcium, Ca.

Decomp. H_2O violently. Slowly attacked by cold H_2SO_4. Dil. H_2SO_4+Aq or HCl+Aq attack violently and dissolve. Dil. HNO_3+Aq oxidises, but fuming HNO_3 scarcely attacks even on boiling. (Bunsen and Matthiessen.) Not attacked by anhydrous alcohol. (Lies-Bodart and Jobin, A. ch. (3) **54.** 364.)

Calcium bromide, $CaBr_2$.
Very deliquescent. 100 pts. H_2O dissolve—

at 0°	20°	40°	60°	105°
125	143	213	278	312 pts. $CaBr_2$.

(Kremers, Pogg. **103.** 65.)

Sp. gr. of $CaBr_2$+Aq. at 19·5° containing:

5	10	15	20	25 % $CaBr_2$,
1·044	1·089	1·139	1·194	1·252
30	35	40	45	50 % $CaBr_2$.
1·315	1·385	1·461	1·549	1·641

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

Very sol. in alcohol. (Henry.)
$+6H_2O$.

Calcium mercuric bromide.
Decomp. by H_2O. (v. Bonsdorff.)

Calcium bromide ammonia, $CaBr_2$, $6NH_3$.
Sol. in H_2O. (Rammelsberg, Pogg. **55.** 239.)

Calcium stannic bromide.
See **Bromostannate, calcium.**

Calcium chloride, $CaCl_2$.
Very deliquescent. Very sol. in H_2O with evolution of heat.

Anhydrous $CaCl_2$ is sol. in 1·459 pts. H_2O. (Gerlach.)

Anhydrous $CaCl_2$ is sol. in 1·58 pts. H_2O at 10·2°. (Kremers, Pogg. **103**. 65.)

Anhydrous $CaCl_2$ is sol. in 1·35 pts. H_2O at 20°; 0·83 pt. H_2O at 40°; 0·72 pt. H_2O at 60°. $CaCl_2+6H_2O$ is sol. in 0·5 pt. H_2O at 0°, and 0·25 pt. at 16°. (Gmelin.)

$CaCl_2$ is sol. in 1·5 pts. cold, and 0·8 pt. boiling H_2O. (Fourcroy.)

$CaCl_2$ + Aq sat. in the cold contains 40·7 % $CaCl_2$. (Fourcroy.)

$CaCl_2$ + Aq sat. at 12·5° contains 53·8 % $CaCl_2$. (Hassenfratz.)

100 pts. H_2O dissolve 165·7 pts. $CaCl_2+6H_2O$ at 0°; 7141 pts. at 40°. (Tilden, Chem. Soc. **45**. 409.)

100 pts. H_2O dissolve 60·3 pts. $CaCl_2$ from $CaCl_2+6H_2O$ at 0°, and solution has sp. gr. = 1·367. (Engel, Bull. Soc. (2) **47**. 318.)

Solubility of $CaCl_2+6H_2O$ in H_2O at t°.

t°	Sat. solution contains % $CaCl_2$	Sat. solution contains % $CaCl_2+6H_2O$
−22	32·24	63·61
0	36·91	72·82
+ 7·39	38·77	76·49
13·86	41·03	80·95
19·35	42·50	83·85
23·46	44·15	87·11
24·47	45·33	89·44
27·71	46·30	91·35
29·53	50·67	99·97

(Hammerl, W.A.B. **72, 2.** 287.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	59·39	13·86	69·49
5	64·83	19·35	73·91
7·88	66·20	21·89	79·77

(Hammerl, calculated by Bakhuis Roozeboom, R. t. c. **8**. 5.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	49·6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126

Solubility in 100 pts. etc.—*Continued.*

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179·5	325
71	136	86	145	...	...

(Mulder, Scheik. Verhandel. **1864**. 107.)

If solubility S = pts. anhydrous $CaCl_2$ in 100 pts. solution, $S=32+0·2148t$ from −18° to +6°; $S=54·5+0·0755t$ from 50° to 120°. (Étard, C. R. **98**. 1432.)

According to Bakhuis Roozeboom, the solubility of $CaCl_2$ varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments.

Solubility of $CaCl_2+6H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
20·4	75·1	28·0	88·8	29·5	96·07
25·05	81·67	28·9	92·05	30·2	102·7

There are two modifications of $CaCl_2+4H_2O$, *α* and *β*.

Solubility of $CaCl_2+4H_2O$ *β* in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
18·4	103·3	35·0	122·74
25·0	108·8	38·4	127·50
30·0	114·1	...	...

Solubility of $CaCl_2+4H_2O$ *α* in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
22·0	92·67	35·95	107·21
24·7	95·59	40·00	115·3
29·8	100·6	45·00	129·9

Solubility of $CaCl_2+2H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
40	128·1	95·8	156·5	139	191·0
45	129·9	115	169·5	155	214·3
50	132·3	124	176·0	165	236·2
59·5	136·5	137	187·6	174	275·7
80·5	145·3	...	...	...	...

Solubility of $CaCl_2+H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$
191	306
235	331

(Bakhuis Roozeboom, R. t. c. **8.** 1.)

Sp. gr. of $CaCl_2$+Aq.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
3·95	1·03	20·85	1·18	34·57	1·33
7·66	1·06	23·93	1·21	36·49	1·36
11·23	1·09	26·86	1·24	38·31	1·39
14·42	1·12	29·67	1·27	40·43	1·42
17·60	1·15	32·35	1·30	41·91	1·45

(Richter.)

Sp. gr. of $CaCl_2$+Aq at 19·5° containing pts. $CaCl_2$ to 100 pts. H_2O.

Pts. $CaCl_2$	Sp. gr.	Pts. $CaCl_2$	Sp. gr.
6·97	1·0545	36·33	1·2469
12·58	1·0954	50·67	1·3234
23·33	1·1681	62·90	1·3806

(Kremers, Pogg. **99.** 444.)

Sp. gr. of $CaCl_2$+Aq. G=sp. gr. at 15° if % is $CaCl_2$, according to Gerlach; S=sp. gr. at 18·3° if % is $CaCl_2+6H_2O$, according to Schiff.

%	G	S	%	G	S
1	1·00852	1·0039	36	1·35610	1·1575
2	1·01704	1·0079	37	1·36790	1·1622
3	1·02555	1·0119	38	1·37970	1·1671
4	1·03407	1·0159	39	1·39150	1·1719
5	1·04259	1·0200	40	1·40330	1·1768
6	1·05146	1·0241	41	...	1·1816
7	1·06033	1·0282	42	...	1·1865
8	1·06921	1·0323	43	...	1·1914
9	1·07808	1·0365	44	...	1·1963
10	1·08695	1·0407	45	...	1·2012
11	1·09628	1·0449	46	...	1·2062
12	1·10561	1·0491	47	...	1·2112
13	1·11494	1·0534	48	...	1·2162
14	1·12427	1·0577	49	...	1·2212
15	1·13360	1·0619	50	...	1·2262
16	1·14332	1·0663	51	...	1·2312
17	1·15305	1·0706	52	...	1·2363
18	1·16277	1·0750	53	...	1·2414
19	1·17250	1·0794	54	...	1·2465
20	1·18222	1·0838	55	...	1·2516
21	1·19251	1·0882	56	...	1·2567
22	1·20279	1·0927	57	...	1·2618
23	1·21308	1·0972	58	...	1·2669
24	1·22336	1·1017	59	...	1·2721
25	1·23365	1·1062	60	...	1·2773
26	1·24450	1·1107	61	...	1·2825
27	1·25535	1·1153	62	...	1·2877
28	1·26619	1·1199	63	...	1·2929
29	1·27704	1·1246	64	...	1·2981
30	1·28789	1·1292	65	...	1·3034
31	1·29917	1·1339	66	...	1·3087
32	1·31045	1·1386	67	...	1·3140
33	1·32174	1·1433	68	...	1·3193
34	1·33602	1·1480	69	...	1·3246
35	1·34430	1·1527	70	...	1·3300

(Calculated by Gerlach, Z. anal. **8.** 283.)

Sp. gr. of $CaCl_2$+Aq: a=no. of *half molecules* in grammes dissolved in 1000 g. H_2O; b=sp. gr. at 24·3° when a=$CaCl_2+6H_2O$ ($\frac{1}{2}$ mol.=109·5 g.); c=sp. gr. at 24·3° when a=$CaCl_2$ ($\frac{1}{2}$ mol.=55·5 g.).

a	b	c	a	b	c
1	1·041	1·043	7	1·198	1·258
2	1·076	1·084	8	1·214	...
3	1·106	1·122	9	1·229	...
4	1·133	1·159	10	1·242	...
5	1·157	1·193	11	1·255	...
6	1·179	1·227	...	...	...

(Favre and Valson, C.R. **79.** 968.)

Sp. gr. of $CaCl_2$+Aq at 18°.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
5	1·0409	25	1·2305
10	1·0852	30	1·2841
15	1·1311	35	1·3420
20	1·1794	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

B.-pt. of $CaCl_2$+Aq containing pts. $CaCl_2$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 440); L=according to Legrand (A. ch. (2) **39.** 43).

B.-pt.	G	L	B.-pt.	G	L
101°	6·0	10	134°	...	117·2
102	11·5	16·5	135	119	...
103	16·5	21·6	136	...	123·5
104	21·0	25·8	138	...	129·9
105	25·0	29·4	140	137·5	136·3
106	29·0	32·6	142	...	142·8
107	32·5	35·6	144	...	149·4
108	35·5	38·5	145	157	...
109	38·5	41·3	146	...	156·2
110	41·5	44·0	148	...	163·2
111	...	46·8	150	178	170·5
112	...	49·7	152	...	178·1
113	...	52·6	154	...	186·0
114	...	55·6	155	200	...
115	55·0	58·6	156	...	194·3
116	...	61·6	158	...	203·0
117	...	64·6	160	222	212·1
118	...	67·6	162	...	221·6
119	...	70·6	164	...	231·5
120	69·0	73·6	165	245	...
121	...	76·7	166	...	241·9
122	...	79·8	168	...	252·8
123	...	82·9	170	268	264·2
124	...	86·0	172	...	276·1
125	...	89·1	174	...	285·5
126	...	92·2	175	292	..
128	...	98·4	176	...	301·4
130	101	104·6	178	305	314·8
130·4	102·67	...	179·5	...	325·0
132	...	110·9	...	...	...

Sat. $CaCl_2$+Aq forms a crust at 150°, and contains 178 pts. $CaCl_2$ to 100 pts. H_2O. (Gerlach.)

Sat. $CaCl_2$+Aq boils at 180°. (Rüdorff.)

B.-pt. of $CaCl_2+Aq$.

% $CaCl_2$	B.-pt.	% $CaCl_2$	B.-pt.
5·6	101°	17·5	104°
10·3	102	20·0	105
14·5	103	...	...

(Skinner, Chem. Soc. **61.** 340.)

B.-pt. of an alcoholic solution of $CaCl_2$.

% $CaCl_2$	B.-pt.
2·4	78·43° + 0·70°
5·39	78·43 + 2·15
8·01	78·43 + 4·18
9·93	78·43 + 5·55
15·94	78·43 + 11·75

(Skinner, *l.c.*)

$+6H_2O$. Very deliquescent. Sol. in H_2O with absorption of much heat.

250 pts. $CaCl_2+6H_2O$ with 100 pts. H_2O at 10·8° lower the temp. 23·2°. (Rüdorff, B. **2.** 68.)

Melts in crystal H_2O at 28° (Tilden, Chem. Soc. **45.** 409); at 30·2° (Bakhuis Roozeboom).

$+4H_2O$. Two modifications. (Bakhuis Roozeboom.)

$+2H_2O$.

$+H_2O$. (Bakhuis Roozeboom.)

Less sol. in HCl+Aq than in H_2O. HCl+Aq sat. at 12° dissolves 27 % $CaCl_2$, which crystallises out with $2H_2O$. (Ditte, C.R. **92.** 242.)

$CaCl_2+KCl$. 100 pts. H_2O dissolve 56 pts. $CaCl_2$ at 7°; 100 pts. H_2O dissolve 31 pts. KCl at 7°; 100 pts. H_2O dissolve 63·5 pts. $CaCl_2+4·9$ pts. KCl at 7°. (Mulder, J.B. **1866.** 67.)

$CaCl_2+NaCl$. 100 pts. H_2O dissolve 53 pts. $CaCl_2$ at 4°, and 56 pts. at 7°; 100 pts. H_2O dissolve 35·7 pts. NaCl at 4°, and 35·7 pts. at 7°; 100 pts. H_2O dissolve 57·6 pts. $CaCl_2+2·4$ pts. NaCl at 4°; 100 pts. H_2O dissolve 59·5 pts. $CaCl_2+4·6$ pts. NaCl at 7°. (Mulder, *l.c.*)

Sol. in sat. KNO_3+Aq. (Fourcroy.)

Sol. in 1 pt. strong boiling alcohol. (Wenzel.)

Sol. in 8 pts. alcohol at 15°, and in 1 pt. spirits of wine. (Bergman.)

Sol. in 0·7 pt. boiling absolute alcohol. (Otto.)

Sol. in 1·43 pts. boiling absolute alcohol at 78·3°. (Graham.)

Sol. in wood-spirit; sol. in lignone (Liebig); insol. in lignone. (Gmelin.)

Insol. in acetone; sol. in butyl alcohol. (Wurtz.)

Sl. sol. in propyl alcohol. (Berthelot.)

Sl. sol. in amyl alcohol. (Bouis.)

Pptd. from alcoholic solution by ether. (Döbereiner.)

Sol. in many compound ethers, as ethyl acetate (Liebig), ethyl lactate (Strecker).

Sol. in considerable quantity in amyl sulphocyanide. (Medlock, Chem. Soc. **1.** 374.)

Sol. in valyl. (Kolbe.)

Very sol. in conc. $HC_2H_3O_2$. (Liebig.)

Insol. in liquid CO_2.

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Calcium lead chloride, basic.
See **Calcium lead oxychloride.**

Calcium magnesium chloride, $CaCl_2$, $2MgCl_2+12H_2O$.

Min. *Tachhydrite.* Deliquescent.

100 pts. H_2O dissolve 160·3 pts. at 18·75°. By dissolving 20 pts. in 80 pts. H_2O the temp. is raised 7·75°. (Bischof.)

Calcium mercuric chloride, basic, $CaCl_2$, $2HgO+4H_2O$.
See **Calcium mercuric oxychloride.**

Calcium mercuric chloride, $CaCl_2$, $5HgCl_2+8H_2O$.

Decomp. by cold H_2O, which dissolves out $CaCl_2$, but all dissolves on heating. (v. Bonsdorff, **1829.**)

$CaCl_2$, $2HgCl_2+6H_2O$. Deliquescent. Very sol. in H_2O. (v. Bonsdorff.)

Calcium stannic chloride.
See **Chlorostannate, calcium.**

Calcium chloride ammonia, $CaCl_2$, $8NH_3$.
Sol. in H_2O with decomp. (Faraday.)

Calcium chloride lead oxide, $CaCl_2$, $3PbO+3H_2O$.
See **Calcium lead oxychloride.**

Calcium chloroferrite, CaO, $CaCl_2$, Fe_2O_3.
Insol. in H_2O. (le Chatelier, C. R. **99.** 276.)

Calcium fluoride, CaF_2.

Sol. in 26,923 pts. H_2O at 15·5°. (Wilson, Ch. Gaz. **1850.** 366.)

When pptd. not completely insol. in H_2O; scarcely sol. in dil., more sol. in conc. HCl+Aq; decomp. by conc. H_2SO_4; not decomp. by dil. alkaline solutions. (Fresenius.)

Not decomp. by conc. H_2SO_4 below 40°, but forms a transparent syrup. CaF_2 is pptd. from this solution by addition of H_2O.

Sol. in conc. HCl, and HNO_3+Aq in the same way, but the liquid is not viscid. Very sl. sol. in HF. Boiling HCl+Aq dissolves slightly. Decomp. by boiling HNO_3+Aq.

Sol. in NH_4 salts+Aq. (Rose.)

Partly decomp. by boiling K_2CO_3, and Na_2CO_3+Aq. (Dulong, A. ch. **82.** 278.)

Min. *Fluorite* (*Fluorspar*). Calculated from electrical conductivity of CaF_2+Aq, 1 l. H_2O dissolves 14 mg. CaF_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Calcium hydrogen fluoride, $CaH_2F_4+6H_2O$.
Decomp. by boiling H_2O. Sol. in HF+Aq. (Fremy, A. ch. (3) **47.** 35.)

Calcium tantalum fluoride.
See **Fluotantalate, calcium.**

Calcium stannic fluoride.
See **Fluostannate, calcium.**

Calcium titanium fluoride.
See **Fluotitanate, calcium.**

Calcium hydride, CaH.
Decomp. by HCl+Aq. (Winkler, B. **24.** 1975.)

Calcium hydrosulphide, CaS_2H_2.

Cryst. with $6H_2O$. Extremely sol. in H_2O and alcohol. ¼ of its weight of H_2O at ordinary temp. more than suffices to hold it in solution. (Divers and Shimidzu, Chem. Soc. **45**. 271.)

Sp. gr. of aqueous solution containing 32 % anhydrous CaS_2H_2 (64 % $CaS_2H_2+6H_2O$) = 1·255; 37·5 % CaS_2H_2 (75·5 % $CaS_2H_2+6H_2O$) = 1·310. (Divers and Shimidzu.)

Calcium hydroxyhydrosulphide, $Ca(OH)SH+3H_2O$.

Easily sol. in H_2O with almost immediate decomposition. Insol. in alcohol, but slowly decomp. thereby. (Divers and Shimidzu, Chem. Soc. **45**. 270.)

Calcium hydroxide, CaO_2H_2.

See also **Calcium oxide.**

Sl. sol. in cold, and less in hot H_2O.

1 pt. CaO dissolves at t° in pts. H_2O.

t°	Pts. H_2O	Authority
20	450	Davy.
0	656	Phillips (A. Phil. **17**. 107).
..	700	Bergman (Essays, etc.).
13	785	Pavesi and Rotondi (B. **7**. 817).
18	780	Bineau (A. ch. (3) **51**. 290).
19·5	806	P. and R. (*l.c.*).
23	814	P. and R. (*l.c.*).
18·75	960	Abl.
54·4	972	Dalton (Syst. **2**. 231).
15·6	778	Dalton (*l.c.*).
15·6	752	Phillips (*l.c.*).
15·6	731	Wittstein (Repert. Pharm. **1**. 182).
15·6	741	Tichborne (Bull. Soc. (2) **17**. 24).
100	1270	Dalton (*l.c.*).
100	1280	Phillips (*l.c.*).
100	1330	Wittstein (*l.c.*).
100	1340	Tichborne (*l.c.*).
100	1500	Bineau (*l.c.*).
109	1758	Tichborne (*l.c.*).

Solubility in H_2O. 1000 pts. CaO_2H_2+Aq sat. at t° contain pts. CaO.

t°	Pts. CaO		
	From Nitrate	Marble	Hydrate
0	1·362	1·381	1·430
10	1·311	1·342	1·384
15	1·277	1·299	1·344
30	1·142	1·162	1·195
45	0·996	1·005	1·033
60	0·884	0·868	0·885
100	0·562	0·576	0·584

(Lamy, C.R. **86**. 333.)

Solubility of CaO_2H_2 in H_2O at t°.

t°	Pts. H_2O to 1 pt. CaO	Pts. CaO in 100 pts. H_2O	t°	Pts. H_2O to 1 pt. CaO	Pts. CaO in 100 pts. H_2O
0	759	0·131	60	1136	0·088
10	770	0·129	70	1235	0·080
20	791	0·126	80	1362	0·073
30	862	0·116	90	1579	0·063
40	932	0·107	100	1650	0·060
50	1019.	0·098	...	...	...

(Maben, Pharm. J. Trans. (3) **14**. 505.)

1 pt. CaO_2H_2 is sol. in 640 pts. H_2O at 19°, and 3081 pts. at 150°. (Shenstone and Cundall, Chem. Soc. **53**. 550.)

1000 g. H_2O dissolve 1·251 g. CaO. (Carles, Arch. Pharm. (3) **4**. 558.)

Solubility of CaO_2H_2 in H_2O. 100 pts. H_2O dissolve pts. CaO at t°.

t°	Pts. CaO	t°	Pts. CaO
20	0·1374	80	0·0845
40	0·1162	100	0·0664
60	0·1026	...	...

(Zahorsky, Z. anorg. **3**. 34.)

Readily sol. in most acids.

Sol. in NH_4Cl+Aq. Much more sol. in $NaCl+Aq$ than in H_2O. (Rose.)

KOH or NaOH + Aq containing 1 pt. KOH or NaOH in 100 pts. H_2O do not dissolve more than $\frac{1}{50000}$ pt. CaO_2H_2, but it is sol. in NH_4OH+Aq. (Pelouze, A. ch. (3) **33**. 11.)

Solubility of CaO_2H_2 in $CaCl_2+Aq$. 100 pts. $CaCl_2+Aq$ of given strength dissolve pts. CaO at t°.

t°	$CaCl_2+Aq$ 5 % $CaCl_2$	$CaCl_2+Aq$ 10 % $CaCl_2$	$CaCl_2+Aq$ 15 % $CaCl_2$	$CaCl_2+Aq$ 20 % $CaCl_2$	$CaCl_2+Aq$ 25 % $CaCl_2$	$CaCl_2+Aq$ 30 % $CaCl_2$
20	0·1370	0·1661	0·1903	0·1857*	0·1661*	0·1630*
40	0·1160	0·1419	0·1781	0·2249	0·3020*	0·3684*
60	0·1020	0·1313	0·1706	0·2204	0·2989	0·3664
80	0·0936	0·1328	0·1736	0·2295	0·3261	0·4122
100	0·0906	0·1389	0·1842	0·2325	0·3710	0·4922

* In these cases, ppts. of $3CaO,CaCl_2+15H_2O$ were formed.

(Zahorsky, Z. anorg. **3**. 34.)

Alcohol dissolves traces.

Insol. in ether.

Much more sol. in glycerine, or sugar + Aq than in H_2O.

Solubility of CaO in glycerine.

Wt. of glycerine in 100 ccm. of solution	Wt. CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to glycerine	
		CaO	Glycerine
10·00	0·370	3·6	96·4
5·00	0·240	4·6	95·4
2·86	0·196	6·4	93·6
2·50	0·192	7·1	92·9
2·00	0·186	8·5	91·5
1·00	0·165	14·2	85·8

(Berthelot, A. ch. (3) **46**. 176.)

1000 g. H_2O dissolve 1·251 g. CaO; 1000 g. H_2O + 50 g. glycerine dissolve 1·865 g. CaO; 1000 g. H_2O + 100 g. glycerine dissolve 2·583 g. CaO; 1000 g. H_2O + 200 g. glycerine dissolve 4·040 g. CaO; 1000 g. H_2O + 400 g. glycerine dissolve 6·569 g. CaO. (Carles, Arch. Pharm. (3) **4**. 558.)

Insol. in pure glycerine.

100 pts. sugar dissolved in H_2O dissolve 55·6 pts. CaO (Osann); 50 pts. CaO (Ure); 49·6 pts. CaO

(Daniell); 29-30·6 pts. CaO (Hunton); 23 pts. CaO. (Soubeiran.)

Sugar solution at 100° takes up ¼ mol. CaO for each mol. sugar; at 0°, if it contains not less than 25 % of sugar, it takes up 2 mols. CaO to 1 mol. sugar. (Dubrunfaut.)

Amount dissolved is proportional to the density and temperature of the solutions.

Solubility of CaO in sugar+Aq.

Pts. sugar dissolved in 100 pts. H_2O	Relation of CaO to sugar	
	CaO	Sugar
40	21·0	79·8
37·5	20·8	79·2
35·0	20·5	79·5
32·5	20·3	79·7
30·0	20·1	79·9
27·5	19·9	80·1
25·0	19·8	80·2
22·5	19·3	80·7
20·0	18·8	81·2
17·5	18·7	81·3
15·0	18·5	81·5
12·5	18·3	81·7
10·0	18·1	81·9
7·5	16·9	83·1
5·0	15·3	84·7
2·5	13·8	86·2

(Peligot, C.R. **32.** 335.)

100 g. solution of sugar sat. with CaO between 10° and 54·4° contain 22·5 to 23·5 % CaO. (Hunton, **1837.**)

Solubility of CaO in dil. sugar solutions.

Wt. of sugar in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to sugar	
		CaO	Sugar
4·850	1·031	17·5	82·5
2·401	0·484	16·8	83·2
2·000	0·433	17·8	82·2
1·660	0·364	18·0	82·0
1·386	0·326	19·0	81·0
1·200	0·316	20·8	79·2
1·058	0·281	21·0	79·0
0·960	0·264	21·6	78·4
0·400	0·194	32·7	67·3
0·191	0·172	47·4	52·6
0·096	0·154	61·6	78·4
0·000	0·148	...	...

(Berthelot, A. ch. (3) **46.** 176.)

Solubility of CaO in mannite+Aq.

Wt. of mannite in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to mannite	
		CaO	Mannite
9·60	0·753	7·3	92·7
4·80	0·372	7·2	92·8
2·40	0·255	9·6	90·4
1·92	0·225	10·5	89·5
1·60	0·207	11·4	88·6
1·37	0·194	12·5	87·5
1·20	0·193	13·9	86·1
1·07	0·190	15·1	84·9
0·96	0·186	16·2	86·8
0·192	0·155	44·6	55·4
0·096	0·154	61·6	38·4
0·000	0·148	...	...

(Berthelot, *l.c.*)

Solutions of CaO in sugar, mannite, or glycerine afford an abundant ppt. on being heated, but this redissolves on cooling. (Berthelot.)

Sol. in sorbine + Aq (Pelouze); sl. sol. in quercite + Aq. Sol. in monobasic Ca saccharate + Aq. (Peligot.) Much more sol. in gelatine + Aq than in pure H_2O.

Calcium iodide, CaI_2.

Deliquescent. 100 pts. H_2O dissolve—

at 0°	20°	40°	43°	92°
192	204	228	286	435 pts. CaI_2.

(Kremers, Pogg. **103.** 65.)

Sp. gr. of CaI_2 + Aq at 19·5° containing:

5	10	15	20	25	30 % CaI_2,
1·044	1·09	1·14	1·198	1·26	1·321
35	40	45	50	55	60 % CaI_2.
1·398	1·477	1·567	1·665	1·78	1·91

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sol. in absolute alcohol. (Gay-Lussac, A. ch. **91.** 57.)

Calcium *per*iodide, CaI_4 (?).

Decomp. by H_2O.

Calcium mercuric iodide, CaI_2, $2HgI_2$.

Decomp. by H_2O. (Boullay.)

CaI_2, HgI_2. Sol. in H_2O. (Boullay.)

Calcium silver iodide, CdI_2, $2AgI + 6H_2O$.

Immediately decomp. by H_2O. (Simpson, Roy. Soc. Proc. **27.** 120.)

Calcium iodide ammonia, CaI_2, $6NH_3$.

(Isambert, C. R. **66.** 1259.)

Calcium oxide, CaO.

Decomp. by H_2O, with evolution of much heat, to form CaO_2H_2, which see for solubility in H_2O, etc.

Calcium *per*oxide, CaO_2.

Very sl. sol. in H_2O; easily sol. in acids, and NH_4 salts + Aq. Insol. in NH_4OH + Aq. (Conroy, Chem. Soc. (2) **11.** 808.)

$+ 8H_2O$. Efflorescent. Difficultly sol. in H_2O with gradual decomp. Insol. in alcohol or ether. (Gay-Lussac and Thénard, A. ch. (2) **8.** 313.)

Calcium oxybromide.

Decomp. by H_2O. (Löwig.)

Calcium oxychloride, $Ca_4O_3Cl_2 + 15H_2O = 3CaO, CaCl_2 + 15H_2O$.

Decomp. by H_2O or alcohol. (Rose.)

Formula is $Ca_2HO_2Cl + 7H_2O$. (Grimshaw, C. N. **30.** 280.)

$+ 16H_2O$. Decomp. by H_2O into CaO_2H_2 and $CaCl_2$ until a maximum of 85 g. $CaCl_2$ are dissolved per litre. (Ditte, C. R. **91.** 576.)

Calcium lead oxychloride, $CaCl_2$, CaO, $2PbO + 4H_2O$.

Sol. in H_2O with decomp. (André, C. R. **104.** 359.)

$CaCl_2$, $3PbO + 3H_2O$. (André.)

Calcium mercuric oxychloride, $CaCl_2$, $2HgO+4H_2O$.

Decomp. immediately by H_2O. (Klinger, B. **16.** 997.)

Calcium oxyiodide, CaO, CaI_2+16H_2O.

(Tassily, Bull. Soc. (3) **9.** 630.)

Calcium oxysulphide, $Ca_4O_3S_4+12H_2O=3CaO$, CaS_4+12H_2O.

Decomp. by H_2O. Not acted on by absolute alcohol. (Schöne, Pogg. **117.** 77.)

According to Geuther (A. **224.** 178) $=CaS_3$, $2CaO+10$, or $11H_2O$. Sol. in dil. $HCl+Aq$ with separation of S.

$Ca_5O_4S_4+18H_2O=4CaO$, CaS_4+18H_2O. Decomp. by H_2O, but not acted on by absolute alcohol. (Schöne, Pogg. **117.** 82.)

According to Geuther (A. **224.** 178) $=CaS_3$, $3CaO+14$, or $15H_2O$.

$Ca_6O_5S_5+20H_2O=5CaO$, CaS_5+20H_2O. (Rose, Pogg. **55.** 433.)

Sol. in 400 pts. cold, decomp. by boiling H_2O (Buchner); sl. sol. in cold, much more in hot H_2O, but it is not deposited on cooling. Aqueous solution sat. at 6°-7·2° has sp. gr. = 1·0105 (Herschel); sol. in alcohol (Gay-Lussac); insol. in alcohol (Gmelin).

Calcium phosphide, CaP.

Deliquescent. Decomp. in moist air or with H_2O. Not attacked by conc. HNO_3, but decomp. by dil. HNO_3+Aq. (Thénard, A. ch. (3) **14.** 14.)

Calcium selenide, $CaSe$.

Sl. sol. in H_2O. Very easily decomp. (Fabre, C. R. **102.** 1469.)

Calcium sulphide, CaS.

500 pts. H_2O dissolve 1 pt. CaS completely; less H_2O dissolves out CaS_2H_2 and leaves CaO_2H_2. Very much H_2O decomposes completely into CaO_2H_2 and H_2S. (Béchamp, A. ch. (4) **16.** 222.)

Not decomp. by H_2O, and only sl. sol. therein at ordinary temp. (Pelouze.)

After 48 hours contact with CaS 1 l. H_2O contains at:

10°	18°	40°	60°	90°
0·15	0·23	0·30	0·48	0·33 g. CaS.

After boiling for 2 hours, 0·27 g. CaS is dissolved; addition of NaCl diminishes solubility, but Na_2SO_4 increases it. Lime-water dissolves at 14° 0·18 g. CaS, the same amount which H_2O dissolves at 60°. Milk of lime dissolves 0·55 g. at 60°. H_2O containing 3 to 79 g. Na_2O per litre dissolves only traces of CaS at 10°, but at 40-60°, or by boiling, a large amount of Na_2S is formed. (Kolb, A. ch. (4) **7.** 126.)

Sol. in 12,500 pts. H_2O at 12·6°. (Scheurer-Kestner, Répert. chim. appl. **1862.** 331.)

Sat. Na_2CO_3+Aq has scarcely any action on CaS, but a dilute solution has more action. (Kolb.)

Sol. in H_2O and sulphur, forming CaS_4.

Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 81.)

Sol. in acids.

Calcium *tetra*sulphide, CaS_4.

Known only in solution.

Calcium *penta*sulphide, CaS_5.

Sol. in H_2O and alcohol. (Berzelius.)

Exists only in aqueous solution. (Schöne, Pogg. **117.** 73.)

Calcium hydroxyl sulphide, $Ca(OH)SH+3H_2O$.

Easily sol. in H_2O with immediate decomp. and separation of $Ca(OH)_2$. Insol. in alcohol, but slowly decomp. thereby. (Divers and Shimidzu, Chem. Soc. **45.** 270.)

Calcium stannic sulphide.

See **Sulphostannate, calcium.**

Calomel.

See **Mercurous chloride.**

Carbamic acid.

Ammonium carbamate acid carbonate (*commercial carbonate of ammonia*).

See **Carbonate carbamate, ammonium hydrogen.**

—— (*salts of hartshorn*), $2NH_4HCO_3$, NH_4CONH_2.

See **Carbonate carbamate, ammonium hydrogen.**

Carbazote silicon, C_2SiN.

Insol. in acids, even HF; also in boiling $KOH+Aq$. (Schützenberger and Colson, C. R. **92.** 1508.)

Carbon, C.

Insol. in all solvents.

Diamond is unacted upon by $KClO_3+$fum. HNO_3; graphite forms graphitic acid by $KClO_3+$fum. HNO_3; amorphous carbon is sol. in $KClO_3+$fum. HNO_3. (Berthelot, A. ch. (4) **19.** 399.)

Diamond is sol. in molten iron at 1160°. Amorphous carbon is insol. in molten iron at 1160°, but becomes sol. therein by heating to 1400°. (Hempel, B. **18.** 998.)

Carbon boride, CB_6.

Insol. in boiling HNO_3+Aq. (Joly, C. R. **97.** 456.)

Carbon *mon*oxide, CO.

Sol. in 50 vols. recently boiled H_2O. (Davy.)
Sol. in 16 vols. H_2O. (de Saussure.)
Sol. in 27 vols. H_2O. (Dalton.)
100 vols. H_2O dissolve 6·2 vols. CO at 18°. (de Saussure.)

Solubility of CO in H_2O: 1 vol. H_2O at t° dissolves V vols. CO reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0·03287	7	0·02796	14	0·02466
1	0·03207	8	0·02739	15	0·02432
2	0·03131	9	0·02686	16	0·02402
3	0·03057	10	0·02635	17	0·02374
4	0·02987	11	0·02588	18	0·02350
5	0·02920	12	0·02544	19	0·02329
6	0·02857	13	0·02504	20	0·02312

(Bunsen's Gasometry, pp. 287, 128, 146.)

Coefficient of absorption $= 0·032874 - 0·00081632t + 0·000016421t^2$. (Bunsen and Pauli, A. **93.** 16.)

Cuprous chloride in an hydrochloric acid or ammoniacal solution, and ammoniacal solutions of cuprous salts absorb large amounts of CO. (Leblanc, C. R. **30.** 488.)

Cuprouschloride dissolved in HCl + Aq absorbs 15-20 vols. CO. (Berthelot, A. ch. (3) **51.** 66.)

Absorbed by KOH, NaOH, $Ba(OH)_2$, and $Ca(OH)_2$ + Aq ; more readily by ether, alcohol, and wood spirit, with formation of formic acid. (Berthelot, A. ch. (3) **61.** 463.)

Sol. in HCN. (Böttinger, B. **10.** 1122.)

1 vol. alcohol absorbs 0·20443 vols. CO gas at all temperatures between 0° and 25°. (Carius, A. **94.** 135.)

100 vols. alcohol (0·84 sp. gr.) dissolve 14·5 vols. CO at 18° ; 100 vols. rectified naphtha (0·784 sp. gr.), 20·0 vols. CO at 18° ; 100 vols. oil of lavender (0·88 sp. gr.), 15·6 vols. CO at 18° ; 100 vols. olive oil (0·915 sp. gr.), 14·2 vols. CO at 18° ; 100 vols. sat. KCl + Aq (1·168 sp. gr.), 5·2 vols. CO at 18°. (de Saussure, **1814.**)

1 vol. oil of turpentine absorbs 0·16 – 0·20 vol. CO. (de Saussure.)

Sol. in ether. (Regnault.)

Insol. in caoutchine.

Coefficient of absorption for petroleum = 0·123 at 20°, and 0·134 at 10°. (Gniewasz and Walfisz, Zeit. phys. Ch. **1.** 70.)

Carbon *di*oxide, CO_2.

Gas.—

H_2O dissolves about its own vol. CO_2 at the ordinary temperature (the solution obtained being of 1·0018 sp. gr.) and pressure, and an additional vol. for the pressure of each additional atmosphere to which it is subjected.

The power of H_2O to absorb CO_2 does not increase in precisely the same ratio as the pressure. (Soubeiran.)

5 vols. CO_2 dissolve in 1 vol. H_2O at 7 atmos. pressure, and much greater pressure is necessary in order to increase the amount of gas dissolved ; but up to 4 or 5 atmospheres the amount of gas dissolved is very nearly proportional to the pressure. (Courbe, J. Pharm. **26.** 121.)

100 vols. H_2O at 12·78° absorb 116 vols. CO_2 (Cavendish) ; at 29·44°, 84 vols. CO_2 (Henry) ; at 15·56°, 106 vols. CO_2 (Saussure) ; at 15·56°, 108 vols. CO_2 (Henry) ; at 15·56°, 100 vols. CO_2 (Dalton).

100 vols. H_2O at t° C. absorb V vols. of CO_2 gas reduced to 60° F. and 30 in. pressure.

t°	V	t°	V
0	175·72	26·7	68·60
4·4	147·94	32·2	57·50
10	122·27	37·8	50·39
15·6	100·50	65·6	11·40
21·1	83·86	100	trace

(Rogers, Am. J. Sci. (2) **6.** 107.)

1 vol. H_2O at 5° absorbs somewhat more than 1 vol. CO_2 ; at 10° scarcely 1 vol., and still less at higher temp. CO_2 + Aq sat. at 2° has 1·0015 sp. gr. ; most of the CO_2 escapes upon exposing the solution to the air, the more quickly the higher the temperature. But as CO_2 diminishes, the remainder is more obstinately held, so that boiling for ½ hour is necessary to expel it completely. (Bergman.)

Solubility of CO_2 in H_2O. 1 vol. H_2O at t° and 760 mm. dissolves V vols. CO_2 gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	1·7967	7	1·3339	14	1·0321
1	1·7207	8	1·2809	15	1·0020
2	1·6481	9	1·2311	16	0·9753
3	1·5787	10	1·1847	17	0·9519
4	1·5126	11	1·1416	18	0·9318
5	1·4497	12	1·1018	19	0·9150
6	1·3901	13	1·0653	20	0·9014

(Bunsen's Gasometry, pp. 287, 128, 152.)

Coefficient of absorption = 1·7967 – 0·07761t + 0·0016424t². (Bunsen.)

Solubility in H_2O at various pressures : P = pressure in atmospheres.

P	Vol. gas in 1 ccm. H_2O		P	Vol. gas in 1 ccm. H_2O	
	at 0°	at 12·43°		at 0°	at 12·43°
1	1·797	1·086	20	26·65	17·11
5	8·65	5·15	25	30·55	20·31
10	16·03	9·65	30	33·74	23·35
15	21·95	13·63	...	...	...

(Wroblewski, C. R. **94.** 1355.)

Absorption of CO_2 in H_2O at various pressures : P = pressure in mm. ; V = vols. CO_2, reduced to 0° and 760° mm., absorbed by 1 vol. H_2O.

P	V	P	V
697·71	0·9441	2188·65	3·1764
809·03	1·1619	2369·02	3·4857
1289·41	1·8647	2554·00	3·7152
1469·95	2·1623	2738·33	4·0031
2002·06	2·9067	3109·51	4·5006

(Khanikoff and Longuinine, A. ch. (4) **11.** 412.)

C = coefficient of absorption in H_2O at t° and 760 mm.

t°	C	t°	C	t°	C
15·2	1·009	18·38	0·896	21	0·838
17·6	0·930	19·3	0·885	23	0·798

(Setschenow, Mém. Acad. St. Petersb. **22.** Nos. 6, 7.)

Sl. sol. in HCl + Aq.

100 vols. H_2SO_4 of 1·840 sp. gr. absorb 45 vols. CO_2. (de Saussure.)

H_2SO_4 of ordinary density at 15·56° and common pressure absorbs 94 % of its vol. of CO_2 ; fuming H_2SO_4, 125 % ; the absorption for pure H_2O under the same conditions being 98 %. (Rogers, Am. J. Sci. (2) **5.** 115.)

H_2SO_4 absorbs 7-10 % CO_2. (Hlasiwetz, W. A. B. **20.** 193.)

Coefficient of absorption by conc. H_2SO_4 = 0·932, which is the same as that by H_2O ; but this diminishes on diluting, and is at its lowest limit 0·666, when the composition of the solution is H_2SO_4,H_2O ; upon further dilution the coefficient of solubility gradually increases, and when 58 H_2O are present to 1 H_2SO_4, the coefficient of absorption is 0·857. (Setschenow, J. B. **1876.** 46.)

In collecting CO_2 gas in pneumatic operations, a saturated solution of common salt is better than H_2O for filling the trough. This solution will only absorb about ⅓ of the amount of CO_2 absorbed by pure H_2O. (Saussure, *l.c.*)

About half as sol. in NaCl + Aq (15 % NaCl) as in H_2O.

Much more sol. in Na_2HPO_4 + Aq or Na_2CO_3 + Aq than in H_2O, the quantity dissolved increasing with the amount of salt in the solution. The solubility in these solutions depends on the coefficient of solubility in H_2O plus the product of a constant coefficient multiplied by the amount of salt in the solution; this constant equals 0·069 for Na_2HPO_4, and 0·088 for Na_2CO_3. (Fernet, A. ch. (3) **47.** 307.)

Fernet's determinations are not accurate. (L. Meyer, A. Suppl. **2.** 157.)

1 mol. Na_2HPO_4 in dil. Na_2HPO_4+Aq absorbs 2 mols. CO_2. (Setschenow.)

Solutions of salts of similar constitution are equivalent in regard to their power of absorption of CO_2, when they contain the same percentage of crystal water. Experiments were made with solutions of alum, $MgSO_4$, $7H_2O$, and $ZnSO_4,7H_2O$, containing 10 % of the salts. The $MgSO_4$ solution absorbed the greatest proportional amount of CO_2, and the alum the least. The further rule was deduced that with salts of similar constitution and the same amount of crystal water, the absorptiometric equivalents are identical with the chemical equivalents. (Setschenow, B. **6.** 1461.)

Salts can be divided into two classes, according as CO_2 has chemical action on the salt or not. In the first case, *i.e.* when there is chemical combination or action of CO_2 on the salt in solution, the amount of CO_2 absorbed increases with increasing concentration of the solution; in the second case, however, the amount of CO_2 decreases with the strength of the solution. Several salts can be arranged in a series as regards their power of absorption, beginning with that which has the greatest, as follows: Na_2CO_3, $Na_2B_4O_7$, Na_2HPO_4, $NaC_2H_3O_2$, $Na_3C_6H_5O_7$, $Na_2C_2O_4$, $NaC_3H_5O_3$, MNO_3, MCl, M_2SO_4. The division between the two classes occurs in this series at $Na_2C_2O_4$.

The matter is discussed at length in the original papers. (Setschenow, Mémoires Acad. St. Petersb. **22.** No. 6. Also further, Setschenow, *ib.* **34.** No. 3. and **35.** No. 7. See also Ostwald, Allgemeine Chemie, 2te Aufl. vol. 1, p. 629.)

More recently (A. ch. (6) **25.** 226) Setschenow has published a very complete paper on the absorption of CO_2 by solutions of salts, which, however, can only be referred to here.

CO_2 is not disengaged at ordinary temp. from H_2O, in which $\frac{1}{1000}$ pt. of $CaCO_3$ or $MgCO_3$ is held in solution thereby. These solutions have a great power of retaining CO_2 even at a boiling temp. or with diminished pressure, and they also absorb CO_2 from the air in much larger quantity than pure H_2O. (Bineau.)

$BaCO_3$ in H_2O also retains CO_2 even after long boiling. (Storer.)

CO_2 is also absorbed from the air by Na_2CO_3, or K_2CO_3+Aq, especially if dilute.

100 vols. of the following solutions at 18° and ordinary pressure absorb vols. CO_2—

	Sp. gr.	Vols. CO_2
Sat. NaCl+Aq (containing 29 % of NaCl) .	1·212	32·9
Sat. NH_4Cl+Aq (containing 27·53 % of NH_4Cl)	1·078	75
Sat. KCl+Aq (containing 26 % of KCl) .	1·168	61
Sat. $CaCl_2$+Aq (containing 40·2 % of $CaCl_2$)	1·402	26·1
Sat. K_2SO_4+Aq (containing 9·42 % of K_2SO_4)	1·077	62
Sat. Na_2SO_4+Aq (containing 11·14 % of Na_2SO_4).	1·105	58
Sat. $K_2Al_2(SO_4)_4$+Aq (containing 9·14 % of $K_2Al_2(SO_4)_4+24H_2O$)	1·047	70
Sat. KNO_3+Aq (containing 20·6 % of KNO_3)	1·139	57
Sat. $NaNO_3$+Aq (containing 26·4 % of $NaNO_3$).	1·206	45
Sat. $H_2C_4H_4O_6$+Aq (containing 58·37 % of $H_2C_4H_4O_6$).	1·285	41

(de Saussure, Gilbert's Ann. Phys. **47.** 167.)

100 vols. alcohol (0·803 sp. gr.) at 18° absorb 200 vols. CO_2.

100 vols. alcohol (0·840 sp. gr.) at 18° absorb 186 vols. CO_2. (de Saussure, *l.c.*)

Solubility of CO_2 in alcohol. 1 vol. alcohol at t° and 760 mm. dissolves V vols. CO_2 gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4·3295	9	3·5844	18	3·0402
1	4·2368	10	3·5140	19	2·9921
2	4·1466	11	3·4461	20	2·9465
3	4·0589	12	3·3807	21	2·9034
4	3·9736	13	3·3178	22	2·8628
5	3·8908	14	3·2573	23	2·8247
6	3·8105	15	3·1993	24	2·7890
7	3·7327	16	3·1438	...	...
8	3·6573	17	3·0908	...	...

(Bunsen's Gasometry, pp. 287, 128, 153.)

Coefficient of absorption $= 4·32955 - 0·09395t + 0·00124t^2$. (Bunsen.)

Much less sol. in 30 % alcohol than in pure alcohol or pure H_2O. (Müller, W. Ann. **37.** 24.)

Coefficient of absorption in chloroform is 0·20376 at 36·57 mm., and 4·43757 at 762 mm. pressure. (Woukoloff, C. R. **109.** 62.)

100 vols. of following liquids absorb vols. CO_2 at 18°—

	Sp. gr.	Vols. CO_2
Ether	0·727	217
Rectified naphtha	0·784	169
Oil of turpentine	0·860	166
Oil of lavender (freshly distilled) .	0·880	191
Oil of thyme	0·890	188
Linseed oil	0·940	156
Olive oil	0·915	151
Gum-arabic+Aq (containing 25 % of the gum)	1·092	75
Cane-sugar+Aq (containing 25 % of sugar)	1·104	72

(de Saussure, *l.c.*)

1 vol. oil of turpentine absorbs 1·7-1·9 vols. CO_2 (Saussure.)

1 vol. spirit at 10° absorbs 2 vols. CO_2. (de Saussure.)

1 vol. olive oil at 10° absorbs 1+vol. CO_2. (de Saussure.)

1 vol. oil of turpentine at 10° absorbs 2 vols. CO_2. (Bergman.)

1 vol. caoutchine absorbs 11 vols. CO_2. (Bergman.)

Coefficient of absorption for petroleum is 1·17 at 20° and 1·31 at 10°. (Gniewasz and Walfisz, Zeit. phys. Ch. **1.** 70.)

100 vols. petroleum absorb 70 vols. CO_2 at 10°. (Robinet, C. R. **58.** 608.)

Liquid.—Not miscible with H_2O, though slightly sol. therein, or with fatty oils; miscible with alcohol, ether, CS_2, and the essential oils. (Thilorier, Mitchell.)

Unacted upon by H_2O; sol. in alcohol, ethers, petroleum, oil of turpentine, and CS_2. (Mareska and Donny.)

Petroleum dissolves 5 to 6 vols. liquid CO_2. (Cailletet, C. R. **75.** 1271.)

Sl. sol. in CS_2. (Cailletet.)

Solid.—When immersed in H_2O, rapidly volatilises and dissolves. With alcohol or ether it forms a semi-fluid mixture. (Channing, Am. J. Sci. (2) **5**. 186.)

Only slightly sol. in anhydrous ether, but may be mixed therewith to a paste. (Thilorier.)

Carbon silicide CSi.

(*Carborundum.*) Not attacked by any acids, even HF; sl. attacked by caustic alkalies or carbonates. (Acheson, C. N. **68**. 179.)

Not attacked by KOH + Aq. (Schützenberger, C. R. **114**. 1089.)

Carbon *mono***sulphide**, CS.

Insol. in H_2O, alcohol, oil of turpentine, or benzene; somewhat sol. in CS_2 or ether; sol. in warm HNO_3; sol. in conc. KOH + Aq. (Sidot, C. R. **81**. 32.)

Carbon *di***sulphide**, CS_2.

Very sl. sol. in H_2O.

1 l. H_2O dissolves 2-3 g. CS_2 (Ckiandi, Bull. Soc. **43**. 562); 3·5-4·52 g. (Peligot, *ib.* **43**. 563).

30 ccm. CS_2 shaken with 8690 ccm. H_2O at 20-23° for 18 days decreased 11 ccm. in 9 days and 1·4 ccm. in the next 3 days by diffused light, and 0·6 ccm. in the last 5 days (no light). Part of the CS_2 was decomp. and 7·85 ccm. were dissolved, therefore H_2O dissolves $\frac{1}{1000}$ of its weight CS_2. (Sestini, Gazz. ch. it. **1**. 473.)

Solubility of CS_2 in H_2O.

100 pts. H_2O dissolve 0·203 pts. CS_2 at 12-13°
" " 0·191 " " 15-16°
" " 0·168 " " 25-27°
" " 0·145 " " 30-33°.

(Page, C. N. **41**. 195.)

Solubility of CS_2 in H_2O. a = g. CS_2 in 1000 ccm. solution at t°.

a	t°	a	t°	a	t°
2·04	0	1·79	20	1·11	40
1·99	5	1·69	25	0·70	45
1·94	10	1·55	30	0·14	49
1·87	15	1·37	35		

(Chancel and Parmentier, C. R. **100**. 773.)

Vapours of CS_2 are most easily absorbed by alcoholic solution of KOH. Sl. absorbed by KOH + Aq, and very slowly by $CuSO_4$, $Pb(C_2H_3O_2)_2$ + Aq, conc. H_2SO_4, or $CaCl_2$ in HCl + Aq. (Berthelot, A. ch. (3) **51**. 74.)

Solubility in alcohol. S = strength of alcohol in per cent by weight; P = pts. CS_2 which dissolve in 10 ccm. alcohol at 17°.

S	P	S	P
100	∞	91·37	5·00
98·5	18·20	84·12	3·00
98·15	13·20	76·02	2·00
96·95	10·00	48·40	0·20
93·54	7·00	47·90	0·00

(Tuchschmidt and Follenius, B. **4**. 583.)

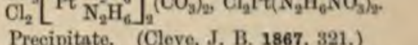
Miscible with absolute alcohol, ether, ethereal and fatty oils, and liquid CO_2.

*Tri***carbon** *di***sulphide**, C_3S_2.

Insol. in H_2O; easily sol. in alcohol, ether, chloroform, benzene, and CS_2. The alcoholic and ethereal solutions decomp. on standing.

Solid modification. Insol. in H_2O and ordinary solvents. Sol. in KOH + Aq. (Lengyel, B. **26**. 2960.)

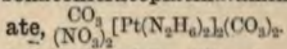
Carbonatochloroplatin*di*amine carbonate chloroplatin*di*amine nitrate.



$\begin{matrix}CO_3\\Cl_2\end{matrix}\left[Pt\begin{matrix}N_2H_6\\N_2H_6\end{matrix}\right]_2(CO_3)_2$, $Cl_2Pt(N_2H_6NO_3)_2$.

Precipitate. (Cleve, J. B. **1867**. 321.)

Carbonatonitratoplatin*di*amine carbonate,



$\begin{matrix}CO_3\\(NO_3)_2\end{matrix}[Pt(N_2H_6)_2]_2(CO_3)_2$.

Sol. in boiling H_2O. (Cleve.)

Carbonatotetramine cobaltic bromide, $Co(NH_3)_4CO_3Br$.

Much less sol. than chloride. (Jörgensen, Z. anorg. **2**. 279.)

—— **carbonate,** $[Co(NH_3)_4CO_3]_2CO_3 + 3H_2O$.

Very sol. in H_2O. (Jörgensen.)

—— **chloraurate,** $[Co(NH_3)_4CO_3]_2AuCl_4 + \frac{1}{2}H_2O$.

Somewhat sol. in H_2O; nearly absolutely insol. in alcohol. (Jörgensen.)

—— **chloride,** $Co(NH_3)_4CO_3Cl$.

Easily sol. in H_2O; insol. in alcohol. (Jörgensen.)

—— **chloroplatinate,** $[Co(NH_3)_4CO_3]_2PtCl_6 + 2H_2O$.

Nearly insol. in H_2O and alcohol. (Jörgensen.)

—— **chloroplatinite,** $[Co(NH_3)_4CO_3]_2PtCl_4$.

Nearly insol. in H_2O; wholly in alcohol. (Jörgensen.)

—— **dithionate,** $[Co(NH_3)_4CO_3]_2S_2O_6$.

Ppt. (Jörgensen.)

—— **iodide,** $Co(NH_3)_4CO_3I$.

Much less sol. than bromide or chloride. (Jörgensen.)

—— **nitrate,** $Co(NH_3)_4CO_3NO_3 + \frac{1}{2}H_2O$.

Sol. in about 15 pts. cold H_2O; insol. in alcohol. (Jörgensen.)

—— **sulphate,** $[Co(NH_3)_4CO_3]_2SO_4 + 3H_2O$.

Considerably less sol. in H_2O than the nitrate. (Jörgensen.)

Carbonic acid, H_2CO_3.

Solution of CO_2 in H_2O has the properties of a solution of H_2CO_3 in H_2O. Decomp. by heat.

See **Carbon** *di***oxide.**

Carbonates.

Carbonates of Na, K, Rb, and Cs are easily sol. in H_2O; carbonates of Li and Tl are much less sol.; other carbonates are nearly or quite insol. All carbonates are sol. to some extent in H_2O containing CO_2. All carbonates, except those of NH_4, Rb, and Cs, are insol. in alcohol.

Sol. in those acids which are themselves sol. in H_2O, except HCN and H_3BO_3.

Aluminum carbonate, basic.

Al_2O_3, CO_2. (Parkmann, Sill. Am. J. (2) **34.** 324.)

$3Al_2O_3$, $2CO_2+16H_2O$. (Muspratt and Danson, A. **72.** 120.)

$3Al_2O_3$, $2CO_2+9H_2O$. (Wallace, Chem. Gaz. **1858.** 410.)

$5Al_2O_3$, $3CO_2+18H_2O$. (Bley, J. pr. **39.** 11.)

$2Al_2O_3$, CO_2+8H_2O. (Urbain and Renoul, J. Pharm. (4) **30.** 340.)

$8Al_2O_3$, $3CO_2+40H_2O$. (Langlois, A. ch. (3) **48.** 505.)

All are precipitates, insol. in H_2O, sol. in acids, and give off CO_2 at slight heat.

Aluminum ammonium carbonate, Al_2O_3, CO_2, $(NH_4)_2CO_3+4H_2O$.

Precipitate. (Rose, Pogg. **91.** 460.)

Aluminum sodium carbonate, Al_2O_3, CO_2, $2Na_2CO_3+24H_2O$.

Precipitate. Sol. in cold dil. acids. (Bley, J. pr. **39.** 22.)

Ammonium carbonate, $(NH_4)_2CO_3+H_2O$.

Sol. at 15° in its own weight H_2O. Solution in H_2O gives off gas at 70-75°, and boils at 75-80°. Sl. sol. in cold dil. NH_4OH+Aq, more sol. at ordinary temp. Insol. in conc. NH_4OH+Aq. (Divers, Chem. Soc. (2) **8.** 171, 359, and 364.)

Insol. in alcohol.

Ammonium hydrogen carbonate, NH_4HCO_3.

Sol. at 15° in about 8 pts. H_2O. (Berthollet, J. Phys. **66.** 168.)

Sol. at 12·8° in about 6 pts. H_2O. (J. Davy, N. Edinb. J. **16.** 245.)

Solution decomp. on air or by gentle heat or by addition of the solid salt. (Berthollet.)

100 pts. H_2O dissolve at 0°, 11·9 pts.; at 10°, 15·85 pts.; at 20°, 21 pts.; at 30°, 27 pts. NH_4HCO_3. (Dibbits, J. pr. (2) **10.** 417.)

Insol. in alcohol. (J. Davy.)

Ammonium *di*hydrogen carbonate, $(NH_4)_4H_2(CO_3)_3+H_2O$.

Sol. in 5 pts. H_2O at 15°; decomp. by more H_2O or by heat. (Divers, Chem. Soc. (2) **8.** 171, 359, and 364.)

Sl. sol. in alcohol.

Ammonium hydrogen carbonate carbamate, $2NH_4HCO_3$, NH_4CONH_2. (*Salts of hartshorn.*)

1 pt. salt dissolves at:

13° in 4 pts. H_2O.
16·7° ,, 3·3 ,,
32·2° ,, 2·7 ,,
40·6° ,, 2·4 ,,
49° ,, 2 ,,

(J. Davy, N. Edinb. J. **16.** 245.)

Strong alcohol dissolves out carbamate, and the carbonate remains undissolved.

NH_4HCO_3, $NH_4CO_2NH_2$. (*Commercial carbonate of ammonia.*)

Sol. at 15° in 4 pts. H_2O, at 65° in 1½ pts. H_2O. (Divers.)

30 pts. salt + 100 pts. H_2O lower temp. from 15·3° to 3·2°. (Rüdorff, B. **2.** 68.)

Sol. in 1·667 pts. cold, and 0·833 pt. hot H_2O. (Fourcroy.)

100 pts. H_2O at 13° dissolve 25 pts.
,, 17° ,, 30 ,,
,, 37° ,, 37 ,,
,, 41° ,, 40 ,,
,, 49° ,, 50 ,,

(Berzelius.)

100 pts. H_2O at 15·5° dissolve 33 pts.; at 100°, 100 pts. (Ure's Dict.)

Sol. in 2 pts. H_2O at 15·5°, and in less than 1 pt. boiling H_2O; sat. solution at 15·5° contains 33·3 %, and sat. boiling solution 50 %. (Abl.)

Sat. aqueous solution at 10° contains 15·7 %. (Eller.)

Sat. aqueous solution at (?) contains 6·1 %. (Mussenbroek.)

Sat. solution in the cold contains 37·5 %. (Fourcroy.)

Does not dissolve as such in H_2O; $(NH_4)_2CO_3$ dissolves out first, and NH_4HCO_3 later. (Scanlan.)

Sp. gr. of carbonate of ammonia + Aq at 12°.

Deg. Tw.	Sp. gr. at 12°.	% Carb. ammon.	Change of sp. gr. for 1° C.
1	1·005	1·66	0·0002
2	1·010	3·18	0·0002
3	1·015	4·66	0·0003
4	1·020	6·04	0·0003
5	1·025	7·49	0·0003
6	1·030	8·93	0·0004
7	1·035	10·35	0·0004
8	1·040	11·86	0·0004
9	1·045	13·36	0·0005
10	1·050	14·83	0·0005
11	1·055	16·16	0·0005
12	1·060	17·70	0·0005
13	1·065	19·18	0·0005
14	1·070	20·70	0·0005
15	1·075	22·25	0·0006
16	1·080	23·78	0·0006
17	1·085	25·31	0·0006
18	1·090	26·82	0·0007
19	1·095	28·33	0·0007
20	1·100	29·93	0·0007
21	1·105	31·77	0·0007
22	1·110	33·45	0·0007
23	1·115	35·08	0·0007
24	1·120	36·88	0·0007
25	1·125	38·71	0·0007
26	1·130	40·34	0·0007
27	1·135	42·20	0·0007
28	1·140	44·29	0·0007
29	1·144	44·90	0·0007

(Lunge, Chem. Ind. **1883.** 2.)

Sp. gr. of aqueous solution of salt with composition 31·3 % NH_3, 56·6 % CO_2, 12·1 % H_2O. 100 pts. of solution contain—

6·58	9·96	14·75	19·83	25·71	pts. salt
1·0219	1·0337	1·0497	1·0672	1·0863	sp. gr.
29·74	35·85	40·23	44·90		pts. salt.
1·0995	1·1174	1·1297	1·1414		sp. gr.

(J. H. Smith, Chem. Ind. **1883.** 3.)

Conc. alcohol dissolves out carbamate and leaves carbonate. (Hünefeld, J. pr. **7.** 25.)

Ammonium cobaltous carbonate, $(NH_4)_2CO_3$, $CoCO_3+4H_2O$.

Permanent. Sol. in H_2O. (Deville, A. ch. (3) **35**. 460.)

$(NH_4)_2O$, $2CoO$, $4CO_2+9H_2O$. Quickly decomp. on air; sol. in H_2O. (Deville.)

$+12H_2O$. Sol. in H_2O.

Ammonium didymium carbonate, $(NH_4)_2CO_3$, $Di_2(CO_3)_3+3H_2O$.

Insol. in H_2O. (Cleve.)

Ammonium glucinum carbonate, $2(NH_4)_2CO_3$, $3GlCO_3$ (?).

Very sol. in cold, decomp. by hot H_2O. Nearly insol. in alcohol. (Debray.)

Composition is $(NH_4)_2CO_3$, $2GlCO_3$, $Gl(OH)_2+2H_2O$. (Humpidge, Royal Soc. Proc. **39**. 1.)

Ammonium magnesium carbonate, $(NH_4)_2Mg(CO_3)_2+4H_2O$.

Sol. in 71 pts. H_2O with decomp.; more sol. in NH_4Cl+Aq. (Divers, Chem. Soc. **51**. 196.)

H_2O containing $(NH_4)_2CO_3$ dissolves very slightly; more sol. in H_2O containing NH_4Cl. (Favre, A. ch. (3) **10**. 473.)

Ammonium magnesium hydrogen carbonate, $(NH_4)_2Mg_2H_2(CO_3)_4+8H_2O$, or $12H_2O$.

Decomp. on air. (Deville, A. ch. (3) **35**. 454.)

Ammonium nickel carbonate, NH_4HCO_3, $NiCO_3+4H_2O$.

Insol. in H_2O. (Deville, A. ch. (3) **35**. 452.)

Ammonium samarium carbonate, $(NH_4)_2CO_3$, $Sm_2(CO_3)_3+4H_2O$.

Ppt.

Ammonium stannous carbonate, $(NH_4)_2CO_3$, $2SnCO_3+3H_2O$.

Decomp. by cold H_2O. (Deville, A. ch. (3) **35**. 456.)

Ammonium uranyl carbonate, $2(NH_4)_2CO_3$, UO_2CO_3.

Sol. at 15° in 20 pts. H_2O, more abundantly in H_2O containing $(NH_4)_2CO_3$. (Ebelmen.)

Insol. in pure H_2O; sol. in H_2O containing $(NH_4)_2CO_3+Aq$. Solution is decomp. by boiling. (Berzelius.)

Sol. in SO_2+Aq. (Berthier, A. ch. (3) **7**. 76.)

Ammonium yttrium carbonate, $(NH_4)_2CO_3$, $Y_2(CO_3)_3+2H_2O$.

Insol. in $(NH_4)_2CO_3+Aq$. (Mosander.)

Ammonium zinc carbonate, basic, $3ZnO$, NH_4OH, $2CO_2+H_2O$.

Insol. in H_2O. (Kassner, Arch. Pharm. (3) **27**. 673.)

Ammonium zinc carbonate, $(NH_4)_2CO_3$, $ZnCO_3$.

Insol. in H_2O. (Deville.)

Quite sol. in H_2O; more sol. than $(NH_4)_2CO_3$, $MgCO_3$. Tolerably permanent in the air. Slowly decomp. by cold, rapidly by hot H_2O.

Very sol. in $(NH_4)_2CO_3+Aq$. Not attacked by alcohol. (Favre, A. ch. (3) **10**. 481.)

Barium carbonate, $BaCO_3$.

Sol. in 4304 pts. cold, and 2304 pts. boiling H_2O. (Fourcroy.)

Sol. in 47,620 pts. H_2O. (Bineau, A. ch. (3) **51**. 290.)

Sol. in 14,137 pts. H_2O at 16-20°, and 15,421 pts. at 100°. (Fresenius.)

Sol. in 12,027 pts. H_2O at 15°. (Kremers, Pogg. **85**. 247.)

Calculated from electrical conductivity of solution, 1 pt. $BaCO_3$ is sol. in 64,070 pts. H_2O at 8·8° and 45,566 pts. at 24·2°. (Hollemann, Z. phys. Ch. **12**. 125.)

Sol. in H_2CO_3+Aq. (See *barium hydrogen carbonate.*)

Easily sol. in dil. acids. Not acted upon by conc. HNO_3+Aq.

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol. Slowly decomp. by 1 pt. HNO_3+6 pts. absolute alcohol. Slowly decomp. by 1 pt. $H_2C_2O_4+6$ pts. absolute alcohol.

Not decomp. by absolute alcoholic solutions of racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, **1816**.)

Almost completely insol. in H_2O containing NH_4OH and $(NH_4)_2CO_3$, when digested in such a solution and allowed to stand. 1 pt. $BaCO_3$ dissolves in 141,000 pts. of such a solution. (Fresenius.)

Not more sol. in $NaCl+Aq$ than in H_2O. (Karsten.)

Sol. in cold NH_4Cl, NH_4NO_3, or NH_4 succinate$+Aq$. (Vogel, J. pr. **7**. 453.)

2 mols. NH_4Cl dissolved in H_2O dissolve 1 mol. $BaCO_3$ by continued boiling. (Smith, Phil. Mag. J. **9**. 540.)

Somewhat sol. in K_2CO_3+Aq. (Wackenroder, A. **24**. 30.)

Slowly sol. in conc. Na_2SO_4, $MgSO_4$, $ZnSO_4$, $Ca(NO_3)_2$, or $CaCl_2+Aq$, but insol. in $ZnCl_2+Aq$. (Karsten.)

Sl. decomp. by boiling K_2SO_4+Aq.

Sl. decomp. in the cold by 1 pt. K_2SO_4+2 pts. Na_2SO_4+Aq.

Decomp. by salts of Al, Mn, Cr, Fe, U, Bi, Cd, Cu, Hg, Pb, Sn^{II}, Sn^{IV}, Hg_2, Rh, Ir, Au, with pptn. of oxide of metal. (Rose, Tr.)

Pptn. of $BaCO_3$ is hindered by presence of alkali citrates or metaphosphates.

Sol. in solutions of various salts, as in the case of calcium carbonate (see *Calcium carbonate*). The solvent power of these solutions for barium carbonate is somewhat less than for calcium carbonate.

Min. *Witherite.*

Barium hydrogen carbonate, $BaH_2(CO_3)_2$ (?).

100 pts. H_2O containing CO_2 dissolve 0·079 pt. $BaCO_3$. (Bineau.)

100 pts. H_2O containing CO_2 dissolve 0·17 pt. $BaCO_3$. (Lassaigne.)

100 pts. H_2O sat. with CO_2 under a pressure of 4-6 atmospheres dissolve 0·725 pt. $BaCO_3$. Upon evaporating, $BaCO_3$ is deposited. (Wagner, Z. anal. **6**. 167.)

$BaCO_3$ is sol. in 833 pts. H_2O sat. with CO_2 at 10°. (Lassaigne.)

$BaCO_3$ is sol. in 830 pts. H_2O sat. with CO_2 at 10°. (Fourcroy.)

$BaCO_3$ is sol. in 1550 pts. H_2O sat. with CO_2 at 10°. (Bergman.)

Barium calcium carbonate, $BaCO_3$, $CaCO_3$.

Min. *Barytocalcite*, *Bromlite*. Sol. in dil. acids.

Bismuth carbonate, basic, $(BiO)_2CO_3 + \frac{1}{2}H_2O$.

Insol. in H_2O; sol. in acids. Insol. in CO_2+Aq. (Bergman.)

Completely sol. in $(NH_4)_2CO_3$+Aq; sl. sol. in K_2CO_3+Aq.; insol. in Na_2CO_3+Aq. (Laugier.)

Absolutely insol. in $(NH_4)_2CO_3$+Aq unless H_3PO_4 or H_3AsO_4 are present. (Berzelius.)

Insol. in $(NH_4)_2CO_3$, K_2CO_3, or Na_2CO_3+Aq. (Rose.)

Sol. in NH_4Cl+Aq. (Wackenroder.) Insol. in NH_4NO_3+Aq. (Brett.) Sol. in $CaCl_2$+Aq. (Pearson.)

Min. *Bismuthosphaerite*.

$3Bi_2O_3$, CO_2. Min. *Bismuthite*. Easily sol. in acids.

$4Bi_2O_3$, $3CO_2 + 4\frac{1}{2}H_2O$. Min. *Bismuth spar*. Easily sol. in acids.

Cadmium carbonate, $CdCO_3$.

Insol. in H_2O; easily sol. in acids; insol. in K_2CO_3, and Na_2CO_3+Aq; very sl. sol. in $(NH_4)_2CO_3$+Aq. (Fresenius.)

Easily sol. in NH_4 sulphate, nitrate, and succinate+Aq. (Wittstein.)

Sol. in KCN+Aq; sol. in cold NH_4Cl+Aq; less sol. in NH_4NO_3+Aq. (Brett, **1837**.)

Not prevented from pptn. by non-volatile organic substances. (Rose.)

Not pptd. from solutions containing sodium citrate. (Spiller.)

$+\frac{1}{2}H_2O$. (Lefort, J. B. **1847**. 346.)

Cæsium carbonate, Cs_2CO_3.

Very deliquescent, and sol. in H_2O.

100 pts. absolute alcohol dissolve 11·1 pts. Cs_2CO_3 at 19°; 20·1 pts. Cs_2CO_3 at boiling temp. (Bunsen.)

Cæsium hydrogen carbonate, $CsHCO_3$.

Not deliquescent. Sol. in H_2O.

Calcium carbonate, basic, CaO, $CaCO_3 + H_2O$.

Hardened by H_2O, but not dissolved. (Raoult, C. R. **92**. 189.)

Calcium carbonate, $CaCO_3$.

More sol. in cold than in hot H_2O. (Gmelin.)

When recently pptd., sol. in 8834 pts. boiling, and 10,601 pts. cold H_2O; much less sol. in H_2O containing NH_4OH and $(NH_4)_2CO_3$, 65,246 pts. of which dissolve 1 pt. $CaCO_3$. (Fresenius (**1846**), A. **59**. 122.)

Sol. in 16,000 pts. pure H_2O. (Brandes, **1825**.)

Sol. in 12,858 pts. pure H_2O at 15°. (Kremers, Pogg. **85**. 247.)

Sol. in 16,000-24,000 pts. pure H_2O. (Bucholz.)

1 l. H_2O dissolves 34 mg. $CaCO_3$. (Chevalet, Z. anal. **8**. 91; Hoffmann, Z. anal. **4**. 414.)

1 l. H_2O may contain 0·016 g. $CaCO_3$, *i.e.* 1 pt. is sol. in 62,500 pts. H_2O. (Bineau, A. ch. (3) **51**. 290.)

1 l. H_2O dissolves 0·02 g. $CaCO_3$, *i.e.* 1 pt. $CaCO_3$ is sol. in 50,000 pts. H_2O. (Peligot.) Solubility is much affected by CO_2 of the air.

1 l. H_2O at 16° dissolves 13·1 mg. $CaCO_3$. (Schlösing, C. R. **74**. 1552.)

Calculated from electrical conductivity of $CaCO_3$+Aq, 1 pt. $CaCO_3$ is sol. in 99,500 pts. H_2O at 8·7°, and 80,040 pts. at 23·8°. (Hollemann, Z. phys. Ch. **12**. 125.)

By continued boiling $CaH_2(CO_3)_2$, 36 mg. $CaCO_3$ remain in solution. (Weltzien, A. **136**. 165.)

Solubility in H_2O at different pressures.

Pressure in atmos.	Solubility.
1	1079
2	1403
4	1820
6	2109

(Engel, C. R. **101**. 949.)

100 pts. H_2O dissolve 0·0005 pt. (calculated as CaO) from pptd. $CaCO_3$, and 0·0027 pt. from calcspar. (Lubavin, J. russ. Soc. **24**. 389.)

Found dissolved in 10,000 pts. sea water. (Davy.)

Pptd. amorphous $CaCO_3$ dissolves in 1600 pts. sea water. Pptd. crystalline $CaCO_3$ dissolves in 8000 pts. sea water. (Irvine and Young, Chem. Soc. **56**. 344.)

For action of H_2CO_3 + Aq, see *Calcium hydrogen carbonate*.

Sol. in H_2SO_4, even when native. Sol. in acids generally. When treated with acids in closed vessels effervescence ceases on increase of pressure, but is renewed at once on removing it. (Link, **1814**.)

Unacted upon by conc. HNO_3, even when boiling, as $Ca(NO_3)_2$ is insol. in conc. HNO_3.

Not decomp. by mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, but immediately by HNO_3+absolute alcohol.

Not decomp. by absolute alcoholic solutions of oxalic, racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, **1816**.)

Unacted upon by glacial $HC_2H_3O_2$, even when boiling.

Freshly pptd. $CaCO_3$ is sol. in cold NH_4Cl+Aq; but the solution becomes cloudy on exposure to air, a portion, however, of $CaCO_3$ remains dissolved, which cannot be pptd. even by boiling. If ppt. is washed and allowed to stand 24 hours, it is not as sol. in NH_4Cl as at first, but natural $CaCO_3$ is not wholly insol. in NH_4Cl+Aq; it is, however, much less sol. than $MgCO_3$. (Vogel, J. pr. **7**. 453.)

Sol. in boiling NH_4Cl+Aq with evolution of NH_3. (Demarçay, **1834**.)

When NH_4OH+Aq, incompletely sat. with CO_2, is mixed with $CaCl_2$+Aq, no ppt. occurs even during several days, if kept in a closed vessel; and only a slight ppt. if the mixture is exposed to the air, but $CaCO_3$ is pptd. if the solution is boiled.

NH_4OH+Aq wholly sat. with CO_2 produces ppt. when mixed with $CaCl_2$+Aq, but pptn. is not complete until heat is applied. Also when an excess of $CaCl_2$+Aq is added to a solution of crystallised carbonate of ammonia, only a portion of the $CaCO_3$ is pptd. until the solution is boiled. (Vogel, **1814**.)

When $CaCl_2$+Aq mixed with NH_4OH+Aq is exposed to an atmos. of pure CO_2, no ppt. occurs for several hours, but $CaCO_3$ is completely pptd. in several days. (Vogel.)

When recently pptd., readily sol. in NH_4Cl, and NH_4NO_3+Aq. (Brett, **1837**; Wackenroder, A. **41**. 315.)

When recently pptd., readily sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, NH_4NO_3, NH_4Cl, and NH_4 succinate+Aq. (Wittstein.)

Sol. in $NH_4C_2H_3O_2$+Aq. (Thomson.)

More sol. in NH_4Cl, or NH_4NO_3+Aq, or in neutral potassium, or sodium salts+Aq than in H_2O. (Fresenius.)

From solutions in NH_4 salts, NH_4OH, and $(NH_4)_2CO_3$+Aq precipitate $CaCO_3$ more completely than $BaCO_3$. (Fresenius.)

When boiled with NH_4Cl+Aq, $CaCO_3$ is dissolved, and $(NH_4)_2CO_3$ given off. (D. Smith.)

$CaCl_2$+Aq prevents pptn. of $CaCO_3$ in the cold, as do also NH_4Cl, KCl, or NaCl+Aq, but it is pptd. when boiled, if the latter solutions are not too conc. K_2SO_4, KNO_3, $(NH_4)_2SO_4$, or Na_2SO_4+Aq have a similar effect. A large excess of $(NH_4)_2CO_3$+Aq when quickly added to $CaCl_2$+Aq produces no ppt. in the cold. Na_2CO_3, or K_2CO_3+Aq act likewise. (Storer, Am. J. Sci. (2) **25**. 41.)

1 g. $CaCO_3$ requires 13·98 g. NH_4Cl, 8·380 g. $(NH_4)_2SO_4$, or 14·438 g. NH_4NO_3 to effect solution. (Bertrand, Monit. Sci. (3) **10**. 477.)

Less sol. in Na than in NH_4 salts, but more than in K salts. (Berthelot.)

When NH_4OH+Aq, partially neutralised by CO_2, is mixed with CaO_2H_2+Aq, no cloudiness appears until the mixture is boiled; when more CO_2 has been added to NH_4OH+Aq a ppt. appears at first, which disappears and only reappears on addition of much CaO_2H_2+Aq; but NH_4OH+Aq does not dissolve pptd. $CaCO_3$. (Vogel.)

CaO_2H_2+Aq dissolves a little $CaCO_3$. (Welter and Berthollet, **1789**.)

CaO_2H_2+Aq retains a little $CaCO_3$ in solution at ordinary temperature, which is pptd. on boiling. (Eliot and Storer, Proc. Am. Acad. (**1860**) **5**. 63.)

CaO_2H_2+Aq, mixed with dil. NaOH, KOH, or NH_4OH+Aq, gives no immediate ppt. when CO_2 is passed through it, unless boiled.

Sol. in boiling $MgCl_2$+Aq even when dilute. (Cousté.)

Not decomp. when boiled with K_2SO_4, Na_2SO_4, $CaSO_4$, $MgSO_4$, and $Na_2B_4O_7$+Aq; but partially decomp. by boiling with $(NH_4)_2SO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, Na_2HPO_4, $(NH_4)_2HPO_4$, K_2HPO_3, Na_2HPO_3, $(NH_4)_2HPO_3$, K_2HAsO_4, Na_3AsO_4, $K_2C_2O_4$, $(NH_4)_2C_2O_4$, NaF, and K_2CrO_4+Aq. With the NH_4 salts the decomposition is complete. (Dulong, A. ch. **82**. 286.)

Not decomp. by alkali sulphates + Aq. (Malaguti.)

Precipitation of $CaCO_3$ is much hindered by alkali citrates or metaphosphates.

Sol. in ferric chloride or nitrate with evolution of CO_2 and pptn. of $Fe_2O_6H_6$ (Fuchs, **1831**); also in chlorides or nitrates of Al, Mn, Cr, or U, but not in $FeCl_2$+Aq.

Sol. in cold $SnCl_4$+Aq with pptn. of SnO_2.

Insol. in conc. Na_2SO_4, $MgSO_4$, $BaCl_2$, $MgCl_2$, $Pb(NO_3)_2$, or $AgNO_3$+Aq. (Karsten.)

Abundantly sol. when freshly precipitated in $CaCl_2$+Aq, and $MgSO_4$+Aq. (Hunt.)

Absolutely insol. at 15-19° in BaO_2H_2+Aq; also on boiling.

1 l. H_2O containing 3-4 g. $MgSO_4$ dissolves 1-2 g. $CaCO_3$, and also 1 g. $MgCO_3$. (Hunt, Am. J. Sci. (2) **26**. 109.)

100 pts. NaCl+Aq (2·525 % NaCl) dissolve 0·0037 pt. (calculated as CaO) pptd. $CaCO_3$, and 0·0053 pt. calcspar. (Lubavin, J. russ. Soc. **24**. 389.)

Alcohol dissolves traces of $CaCO_3$. (Grischow.)

Sol. in Na citrate +Aq. (Spiller.)

Sol. in Ca sucrate +Aq. (Barreswill.)

Min. *Calcite, Arragonite.*

+$5H_2O$. Efflorescent.

+$6H_2O$. (Pelouze.)

Calcium hydrogen carbonate, $CaH_2(CO_3)_2$ (?).

Known only in aqueous solution.

$CaCO_3$ dissolves in CO_2+Aq.

$CaCO_3$ is sol. in 1428 pts. H_2O sat. with CO_2 at 0°, and 1136 pts. at 10°. (Lassaigne, J. ch. méd. **4**. 312.)

Bineau could dissolve, even in large quantities of H_2O sat. with CO_2, only ½ enough $CaCO_3$ to form $CaH_2(CO_3)_2$.

Chalk dissolves in 994·5 pts. H_2O sat. with CO_2, while Iceland spar requires 3149 pts. (Bischof.)

$CaCO_3$ is sol. in 1015 pts. H_2O sat. with CO_2 at 21° and 748·3 mm. (Warington, Chem. Soc. **6**. 296.)

Solubility of $CaCO_3$ in CO_2+Aq at p pressure in atmospheres. $CaO+CO_2$=mg. CO_2 and CaO dissolved, corresponding to $CaCO_3$= mg. $CaCO_3$.

p	$CaO+CO_2$	$CaCO_3$
0·000504	60·96	74·6
0·000808	72·11	85·0
0·00333	123	137·2
0·01387	218·4	223·1
0·0282	310·4	296·5
0·05008	408·5	360
0·1422	...	533
0·2538	1072	663·4
0·4167	1500	787·5
0·5533	1846	885·5
0·7297	2270	972
0·9841	2864	1086

(Schlösing, C. R. **74**. 1522.)

With high pressure 1 l. H_2O containing CO_2 dissolves at most 3 g. $CaCO_3$. This maximum is reached at 5° under 4 atmospheres' pressure; at 10-13° under 5 atmospheres; and at 20° under 7 atmospheres. (Caro, Arch. Pharm. (3) **4**. 145.)

$CaCO_3$ is sol. in about 1000 pts. H_2CO_3+Aq, and solubility is considerably increased by Na_2SO_4 or $MgSO_4$.

1000 pts. H_2O sat. with CO_2 dissolve pts. Carrara marble at t°, and B = height of barometer in millimetres.

t°	B	Pts. $CaCO_3$	t°	B	Pts. $CaCO_3$
7·5	754	1·224	22·0	746	0·920
8·5	752	1·202	26·0	740	0·875
9·5	754	1·115	26·5	743	0·860
20·5	741	0·975	27·0	741	0·885
21·5	744	0·935	28·0	737	0·770

Or, from 7·5-9·5°, 1000 pts. H_2O sat. with CO_2 dissolve 1·181 pts. $CaCO_3$; from 20·5-22°, 0·9487 pt. $CaCO_3$; from 26-28°, 0·855 pt. $CaCO_3$.

Other varieties of $CaCO_3$ are dissolved as follows in 1000 pts. H_2O sat. with CO_2.

Variety	t°	B	Pts. $CaCO_3$
Lüneburg chalk	18	740	0·835
Pptd. $CaCO_3$	18	740	0·950
Iceland spar	18	735	0·970
Calcite	12	754	1·223
Traversella	12	754	1·212
Dolomite, semi-transparent	11·5	749	0·654
Dolomite, opaque, in small crystals	11·5	755	0·725
Dolomite, opaque, in large crystals	11	746	1·224
Dolomite, transparent, in large crystals	11	749	1·073
Oolithic limestone	15	747	1·252
Dolomitic limestone	15·5	740	0·573

(Cossa, Z. anal. **8.** 145.)

Calcium copper uranium carbonate, $CaCO_3$, $3CuCO_3$, $4U(CO_3)_2+24H_2O$.

Sol. in acids.

Calcium lead carbonate, $xCaCO_3$, $yPbCO_3$.

Min. *Plumbocalcite.*

Calcium magnesium carbonate, $CaCO_3$, $MgCO_3$.

Min. *Dolomite.* 1 l. H_2O sat. with CO_2 at 18° and 750 mm. dissolves 0·31 g. dolomite. (Cossa, B. **2.** 697.)

Not obtained by evaporating solution, but can be crystallised from CO_2+Aq between 100° and 200°. (Hoppe-Seyler.)

Insol. in cold dil. acids. (Dolomieu, J. Phys. **39.** 1.)

Insol. in cold acetic acid. (Forchhammer.)

Calcium sodium carbonate, $CaNa_2(CO_3)_2$.

Anhydrous. Decomp. by H_2O.

$+5H_2O$. Min. *Gaylussite.* Sparingly sol. in H_2O.

Calcium uranyl carbonate, $CaCO_3$, $UO_2CO_3+20H_2O$.

Min. *Liebigite.* Sol. in HCl+Aq.

$UCa_2C_4O_{12}+10H_2O$. Min. —— (?). Sol. in acids.

Calcium carbonate chloride, $CaCO_3$, $CaCl_2+6H_2O$.

Sol. in H_2O with immediate decomp. (Fritzsche, J. pr. **83.** 213.)

Cerous carbonate, $Ce_2(CO_3)_3+5$, and $9H_2O$.

Insol. in H_2O, and solution of CO_2 in H_2O. (Vauquelin.)

Somewhat sol. in $(NH_4)_2CO_3$+Aq. (Jolin.)

Insol. in neutral salt solutions and neutral alkali carbonates+Aq; easily sol. in SO_2+Aq. (Berthier, A. ch. (3) **7.** 77.)

Ceric carbonate, $Ce(CO_3)_2+\frac{1}{2}H_2O$.

Precipitate. (Hisinger, A. ch. **94.** 108.)

Insol. in H_2O. Sol. in slight traces in Na_2CO_3+Aq; sl. sol. in $NaHCO_3$+Aq, and in $(NH_4)_2CO_3$+Aq. (Rose.)

Cerous lanthanum carbonate fluoride.

Min. *Batnaesite, Hamartite, Hydrofluocerite.* Slowly decomp. by HCl+Aq, easily by H_2SO_4.

Cerous potassium carbonate, $Ce_2(CO_3)_3$, $K_2CO_3+3H_2O$.

Ppt. (Jolin.)

Cerous sodium carbonate, $Ce_2(CO_3)_3$, $2Na_2CO_3+2H_2O$.

Ppt. (Jolin.)

Chromous carbonate, $CrCO_3$.

Sol. in much H_2O; sl. sol. in $KHCO_3$+Aq. (Moberg, J. pr. **44.** 328; Moissan, A. ch. (5) **21.** 199.)

Chromic carbonate, basic, Cr_2O_3, $2CO_2$.

Precipitate. (Parkmann, Sill. Am. J. (2) **34.** 321.)

Cr_2O_3, CO_2+4H_2O. Insol. in H_2O; sol. in acids; when freshly pptd. is sol. in K_2CO_3, or $(NH_4)_2CO_3$+Aq, and still more sol. in KOH+Aq. (Meissner.)

$2Cr_2O_3$, CO_2+6H_2O. Precipitate. (Langlois, A. ch. (3) **48.** 502.)

Cobaltous carbonate, basic, 5CoO, $2CO_2+4H_2O$.

Insol. in H_2O; sol. in $(NH_4)_2SO_4$, $(NH_4)_2CO_3$, NH_4NO_3, and NH_4Cl+Aq.

Sol. in cold NH_4NO_3, and NH_4Cl+Aq. (Brett, **1837.**)

Sol. in CO_2+Aq, and acid alkali carbonates+Aq, from which it is pptd. on boiling. Very sl. sol. in conc. Na_2CO_3, or K_2CO_3+Aq; largely sol. in $(NH_4)_2CO_3$+Aq, and partly sol. in NH_4OH+Aq. (Berzelius.)

Not pptd. from solutions containing Na citrate. (Spiller.)

4CoO, CO_2+4H_2O. Ppt. (Beetz.)

3CoO, CO_2+3H_2O. (Rose, Pogg. **84.** 551.)

3CoO, $2CO_2+4H_2O$. (Bratin, Z. anal. **6.** 76.)

2CoO, $CO_2+3\frac{1}{2}H_2O$. Converted into 5CoO, $2CO_2+4H_2O$ by H_2O. (Beetz.)

Cobaltous carbonate, $CoCO_3$.

Anhydrous. Not attacked by cold conc. HCl, or HNO_3+Aq. (Senarmont, A. ch. (3) **30.** 129.)

Min. *Sphærocobaltite.* Sl. attacked by cold HNO_3, or HCl+Aq.

$+\frac{3}{2}H_2O$. Sol. in acids. (Deville, A. ch. (3) **33**. 95.)
$+6H_2O$. (Deville.)
Decomp. by H_2O with formation of a basic carbonate. (Berzelius.)

Cobaltous potassium carbonate, $CoCO_3$, $K_2CO_3 + 4H_2O$.

Decomp. by H_2O. (Deville, A. ch. (3) **33**. 90.)
$CoCO_3$, $KHCO_3 + 4H_2O$. Decomp. by H_2O. (Deville.)

Cobaltous sodium carbonate, $CoCO_3$, $Na_2CO_3 + 4H_2O$, and $10H_2O$.

Decomp. by H_2O. (Deville, A. ch. (3) **33**. 75.)

Cupric carbonate, basic.

$8CuO$, $CO_2 + 5H_2O$. (Deville, A. ch. (3) **33**. 75.)
$6CuO$, CO_2. (Field, Chem. Soc. **14**. 70.)
$3CuO$, $CO_2 + 2H_2O$. (Favre, A. ch. (3) **10**. 119.)
$5CuO$, $2CO_2 + 6H_2O$. (Struve.)
$2CuO$, $CO_2 + H_2O$. Insol. in H_2O; easily sol. in acids, even $H_2SO_3 + Aq$; sl. sol. in $H_2CO_3 + Aq$, 30,720 pts. of the solution containing 1 pt. CuO. (Jahn.) Sol. in 4690 pts. $H_2CO_3 + Aq$ sat. at 4-6 atmos. pressure. (Wagner.) Sol. in 3833 pts. sat. $H_2CO_3 + Aq$. (Lassaigne, J. ch. méd. **4**. 312.)
Sol. in NH_4 salts + Aq. Partially sol. in Na_2CO_3, or $K_2CO_3 + Aq$, and more sol. in $NaHCO_3$, or $KHCO_3 + Aq$; sol. in $(NH_4)_2CO_3 + Aq$. (Favre, A. ch. (3) **10**. 18.)
Less sol. in $(NH_4)_2CO_3 + Aq$ than CuO in $NH_4OH + Aq$. (Thomson, **1831**.) Sol. in KCN + Aq. (Berzelius.) Sol. in NH_4Cl, or $NH_4NO_3 + Aq$. (Brett.)
Not pptd. from solutions containing sodium citrate. (Spiller.) Sol. in ferric salts with pptn. of $Fe_2O_6H_6$. Sol. in ethyl amine carbonate + Aq. (Wurtz.)
Min. *Malachite*. Sol. in acids, and $NH_4OH + Aq$.
$+2H_2O$. (Favre.)
$3CuO$, $2CO_2 + H_2O$. Insol. in H_2O. Sol. in $NH_4OH + Aq$, also in hot conc. $NaHCO_3 + Aq$.
Min. *Azurite*.

Cupric potassium carbonate, $5CuCO_3$, $K_2CO_3 + 10H_2O$.

Decomp. by H_2O.

Cupric sodium carbonate, $CuCO_3$, Na_2CO_3.

Not decomp. by cold H_2O. (Debray, C. R. **49**. 218.)
$+3H_2O$.

Cupric zinc carbonate, $2CuO$, $3ZnO$, $2CO_2 + 3H_2O$, or $3CuO$, $9ZnO$, $4CO_2 + 8H_2O$.

Min. *Aurichalcite*. Easily sol. in HCl + Aq.

Cupric carbonate ammonia (cuprammonium carbonate), $CuCO_3$, $2NH_3$.

Decomp. by H_2O. Insol. in alcohol and ether. Sol. in $(NH_4)_2CO_3 + Aq$. (Favre, A. ch. (3) **10**. 116.)

Didymium carbonate, $Di_2(CO_3)_3 + H_2O$, or $6H_2O$.

Insol. in H_2O. Only traces dissolve in CO_2 + Aq. Insol. in solutions of alkali carbonates or bicarbonates + Aq. (Marignac, A. ch. (3) **38**. 166.) Very sl. sol. in conc. $NH_4Cl + Aq$. (Rose.)
$+8H_2O$. (Cleve, Bull. Soc. (2) **43**. 363.)

Didymium potassium carbonate, $Di_2(CO_3)_3$, $K_2CO_3 + 4H_2O$.

Insol. in H_2O. (Cleve, Bull. Soc. (2) **43**. 363.)
$+12H_2O$. (Cleve.)

Didymium sodium carbonate, $2Di_2(CO_3)_3$, $3Na_2CO_3 + 9H_2O$.

Ppt. (Cleve.)
$Di_2(CO_3)_3$, $2Na_2CO_3 + 8H_2O$. Ppt. (Cleve.)

Erbium carbonate, Er_2O_3, $2CO_2 + 2H_2O$.

Insol. in H_2O. (Höglund.)

Erbium sodium carbonate, $Er_2(CO_3)_3$, $5Na_2CO_3 + 36H_2O$.

Efflorescent. Decomp. by H_2O.

Glucinum carbonate, basic, $3GlO$, CO_2; $4GlO$, CO_2; $5GlO$, $CO_2 + 5H_2O$, etc.

Not perceptibly sol. in H_2O or $H_2CO_3 + Aq$. Decomp. by boiling H_2O. Easily sol. in acids. Sol. in NH_4 salts, and KOH, or NaOH + Aq. Sol. in alkali carbonates, especially $(NH_4)_2CO_3 + Aq$. (Vauquelin.) Sl. sol. in $K_2CO_3 + Aq$. When solution in $(NH_4)_2CO_3$ is boiled, a more basic carbonate is pptd. (Rose.)

Glucinum carbonate, $GlCO_3 + 4H_2O$.

Efflorescent. Sol. in 278 pts. H_2O. (Klatzo, J. pr. **106**. 242.)

Glucinum potassium carbonate, $3GlCO_3$, $2K_2CO_3$.

Easily sol. in H_2O, but decomp. by boiling. (Debray.) Less easily sol. in alcohol.

Indium carbonate, $In_2(CO_3)_3$.

Ppt. Insol. in K_2CO_3, or $Na_2CO_3 + Aq$. Sol. in $(NH_4)_2CO_3 + Aq$. (Winkler, J. pr. **94**. 1.)

Iron (ferrous) carbonate, $FeCO_3$.

Insol. in H_2O. Sol. in acids, even in $H_2CO_3 + Aq$. See *Carbonate, ferrous hydrogen*.
Min. *Siderite*, *Spathic ore*. Sl. attacked by dil. acids. Sol. in $H_2CO_3 + Aq$ under pressure. *See* $FeH_2(CO_3)_2$.
Insol. in NH_4Cl, or $NH_4NO_3 + Aq$. (Brett.)
$+H_2O$. Sl. sol. in H_2O; easily sol. in acids; sol. in $H_2CO_3 + Aq$.
Sol. in $NH_4Cl + Aq$. Sol. in ferric salts + Aq with evolution of CO_2 and pptn. of $Fe_2O_6H_6$.
Soluble in an aqueous solution of cane sugar.
Min. —— (?). Scarcely decomp. by acids. (Moissan, C. R. **59**. 238.)

Ferrous hydrogen carbonate, $FeH_2(CO_3)_2$ (?).

Known only in aqueous solution.
By conducting CO_2 at ordinary pressure through H_2O in which Fe is suspended, a solution containing 9·1 pts. $FeCO_3$ to 10,000 pts. H_2O is obtained. (v. Hauer, J. pr. **81**. 391.)
100 pts. $H_2CO_3 + Aq$ dissolve 0·72 pt. $FeCO_3$. (Wagner.)
$FeCO_3$ dissolves in 1381 pts. H_2O saturated with CO_2, under a pressure of 6-8 atmospheres. (Wagner, J. B. **1867**. 135.)

Ferric carbonate, basic.

$9Fe_2O_3, CO_2+12H_2O$. (Wallace, Chem. Gaz. **1858**. 410.)

$3Fe_2O_3, CO_2+4H_2O$, and $8H_2O$. (Barrat, C. N. **1**. 110.)

$+6H_2O$. (Wallace.)

$2Fe_2O_3, CO_2+1\frac{1}{2}H_2O$. (Rother, Pharm. J. Trans. (3) **4**. 576.)

Fe_2O_3, CO_2. (Parkmann, Sill. Am. J. (2) **34**. 321.)

These and other similar basic salts are ppts. easily decomp. on standing into $Fe_2O_6H_6$.

Ferrous magnesium carbonate, $FeCO_3, MgCO_3$.

Min. *Pistomesite.*

$FeCO_3, 2MgCO_3$.

Min. *Mesitite.*

Lanthanum carbonate, $La_2(CO_3)_3+H_2O, 3H_2O$, and $8H_2O$.

Insol. in H_2O. CO_2+Aq dissolves traces. Insol. in $(NH_4)_2CO_3+Aq$.

Min. *Lanthanite.*

Lead carbonate, basic, $2PbCO_3, PbO_2H_2$; $5PbCO_3, 3PbO_2H_2$; $3PbCO_3, PbO_2H_2$; $5PbCO_3, PbO_2H_2$.

White Lead. Insol. in H_2O. Nearly insol. in H_2CO_3+Aq, even under pressure. Sol. in dil., insol. in conc. $KOH+Aq$. Insol. in normal, or acid alkali carbonates + Aq. (Böttger.)

Sol. in cold dil. NH_4Cl+Aq. (Brett.)

$PbCO_3, PbO_2H_2$. Very sl. sol. in H_2O. (Yorke.)

$2PbCO_3, PbO_2H_2$. When not exposed to air, sol. in 32,000 pts. $(NH_4)_2SO_4+Aq$ (0·2 g. per l.); 26,000 pts. KNO_3+Aq (0·2 g. per l.); 23,000 pts. $CaCl_2+Aq$ (0·2 g. per l.); 4600 pts. NH_4NO_3+Aq (0·2 g. per l.); 4300 pts. H_2O sat. with CO_2.

When exposed to air in beakers, sol. in 43,000 pts. $(NH_4)_2SO_4+Aq$ (0·2 g. per l.); 43,000 pts. KNO_3+Aq (0·2 g. per l.); 26,000 pts. $CaCl_2+Aq$ (0·2 g. per l.); 26,000 pts. NH_4NO_3+Aq (0·2 g. per l.); 4300 pts. H_2O sat. with CO_2 (0·2 g. per l.). (Muir, Chem. Soc. **31**. 664.)

Lead carbonate, $PbCO_3$.

Sol. in 50,551 pts. H_2O at ordinary temp.

Sol. in 23,450 pts. H_2O with little ammonium acetate, carbonate, and free ammonia; and in somewhat less H_2O, containing much ammonium nitrate with carbonate and free ammonia. (Fresenius, A. **59**. 124.)

Calculated from electrical conductivity of $PbCO_3+Aq$, 1 l. H_2O dissolves 3 mg. $PbCO_3$ at 10°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Easily sol. in acids, even $HC_2H_3O_2$; but not decomp. by conc. HNO_3+Aq on account of insolubility of $Pb(NO_3)_2$ in HNO_3+Aq. Insol. in a mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, or in an alcoholic solution of racemic or tartaric acids.

Insol. in H_2CO_3+Aq. (Jahn, A. **28**. 117.) Very sl. sol. in H_2CO_3+Aq, but solution is prevented by traces of various salts. (Tünnerman.) Sol. in 7144 pts. sat. H_2CO_3+Aq. (Lassaigne, J. ch. méd. **4**. 312.) H_2O sat. with CO_2 under 4-6 atmos. pressure dissolves only traces of Pb; 1000 pts. of solution containing 0·5 pt. $PbCO_3$. (Wagner, Z. anal. **6**. 167.)

Sol. in $NH_4C_2H_3O_2+Aq$, and NH_4Cl+Aq. (Weppen, **1837**.) Sol. in $KOH+Aq$; not absolutely insol. at ord. temp. in an excess of K_2CO_3, or Na_2CO_3+Aq, and still more sol. at 100°; but absolutely insol. in $NaHCO_3$, $KHCO_3$, or $(NH_4)_2CO_3+Aq$. (Rose.) Insol. in NH_4OH+Aq; sol. in KOH or $NaOH+Aq$; decomp. by boiling $Ca(NO_3)_2+Aq$. (Berzelius.) Sol. in an aqueous solution of acetates. (Mercer, **1844**.)

Not pptd. in presence of Na citrate. (Spiller.) Not decomp. by K_2SO_4+Aq. (Rose.)

Sl. decomp. (Persoz), not at all decomp. (Malaguti) by alkali sulphates + Aq.

Partially decomp. by boiling with K_2SO_4, Na_2SO_4, $(NH_4)_2SO_4$, $CaSO_4$, $MgSO_4$, Na_2HPO_4, $NaNH_4HPO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, Na_2HPO_3, $Na_2B_4O_7$, K_3AsO_4, Na_3AsO_4, $K_2C_2O_4$, $Na_2C_2O_4$, NaF, and K_2CrO_4+Aq. With the NH_4 salts, the decomp. is complete. (Dulong, A. ch. **82**. 290.)

Easily sol. in hot NH_4Cl+Aq. (Brett; Rose.)

When 1 mol. $PbCO_3$ is boiled with 1 mol. $K_2C_2O_4$, 15 % of the $PbCO_3$ is decomp.; with 1 mol. K_2CO_3, 93·28 % is decomp. (Malaguti.)

Min. *Cerussite.*

Lead sodium carbonate, $4PbCO_3, Na_2CO_3$.

Insol. in H_2O. (Berzelius, Pogg. **47**. 199.)

Lead carbonate bromide, $PbCO_3, PbBr_2$.

Insol. in H_2O. (Storer's Dict.)

Lead carbonate chloride, $PbCO_3, PbCl_2$.

Insol. in H_2O. (Miller, Chem. Soc. (2) **8**. 37.)

Min. *Phosgenite.* Easily sol. in acids.

Lead carbonate iodide, $PbCO_3, PbI_2$.

Insol. in H_2O. (Poggiale.)

Lead carbonate sulphate, $PbCO_3, PbSO_4$.

Min. *Lanarkite.* Sol. in HNO_3+Aq with residue of $PbSO_4$.

$3PbCO_3, PbSO_4$. Min. *Leadhillite.* As above.

Lithium carbonate, Li_2CO_3.

100 pts. H_2O dissolve 1 pt. Li_2CO_3. (Vauquelin, A. ch. **7**. 284.)

100 pts. H_2O at 13° dissolve 0·769 pt. Li_2CO_3; at 102°, 0·778 pt. Li_2CO_3. (Kremers, Pogg. **99**. 48.)

100 pts. H_2O, cold or hot, dissolve 1·2 pts. Li_2CO_3. (Troost, A. ch. (3) **51**. 103.)

Sat. solution boils at 102°. (Kremers.)

100 pts. H_2O dissolve 0·796 pt., or 0·955 pt. Li_2CO_3 at b.-pt., according as the solution is boiled ¼, or ½ hour. (Bewad, B. **17**. 406 R.)

100 pts. H_2O dissolve 1·4787 pts. at 15°, 0·7162 pt. at 100°. (Draper, C. N. **55**. 169.)

100 pts. H_2O dissolve pts. Li_2CO_3 at t°.

t°	Pts. Li_2CO_3	t°	Pts. Li_2CO_3
0	1·539	75	0·866
10	1·406	100	0·728
20	1·329	102	0·796
50	1·181	...	...

0·796 pt. is dissolved at 102° in less than ½ hour, and 0·955 in 1 hour. (Beketow, J. russ. Soc. **1884**. 591.)

Sat. solution at 15° has sp. gr. 1·014, and contains 1 g. Li_2CO_3 to 70 g. H_2O, while solution sat. at 0° has sp. gr. 1·0168 and contains 1 g. Li_2CO_3 in 64·6 g. H_2O. By long spontaneous evaporation at 15° a solution can be obtained of 1·0278 sp. gr. containing 1 g. Li_2CO_3 in 45·57 g. H_2O. (Flückiger, Arch. Pharm. (3) **25**. 549.)

By boiling for an instant with H_2O a solution is obtained, which has sp. gr. 1·0074 and contains 1 g. Li_2CO_3 to 139 g. H_2O. (Flückiger, Arch. Pharm. (3) **26**. 543.)

More sol. in CO_2+Aq than in H_2O. 100 pts. sat. CO_2+Aq dissolve 5·25 pts. Li_2CO_3. (Troost.)

Sol. in NH_4 salts+Aq. Insol. in alcohol.

Lithium hydrogen carbonate, $LiHCO_3$.

100 pts. H_2O dissolve 5·501 pts. at 13°. (Bewad, B. **17**. 406 R.)

Magnesium carbonate, basic, $Mg_3C_2O_7+3H_2O$ $=3MgO, 2CO_2+3H_2O$ or $2MgCO_3, MgO_2H_2$ $+2H_2O$. (Fritzsche, Pogg. **37**. 310.)

Magnesia alba, $3MgCO_3$, $Mg(OH)_2+4H_2O$, $4MgCO_3$, $Mg(OH)_2+5H_2O$, or $5MgCO_3$, $2Mg(OH)_2+7H_2O$.

Very sl. sol. in H_2O. Sol. in 10,000 pts. hot or cold H_2O. (Bineau.)

Sol. in 2500 pts. cold, and 9000 pts. hot H_2O. (Fyfe.)

Sol. in H_2O containing CO_2.

Very easily sol. in acids.

Easily sol. in dil. HCl+Aq.

Easily sol. in NH_4 sulphate, nitrate, or succinate+Aq, also in $(NH_4)_2CO_3$+Aq. (Wittstein.) Sol. in cold Na_2CO_3, K_2CO_3, K_2SO_4, KCl, or KNO_3+Aq (Longchamp); also in NH_4Cl+Aq, separating out on heating. (Vogel, J. pr. **7**. 455.) Slowly sol. in conc. $BaCl_2$, $CaCl_2$, or $ZnSO_4$+Aq. (Karsten.)

Sol. in $MgSO_4$+Aq. (Dulong.)

Sol. in ferric salts +Aq with evolution of CO_2 and pptn. of $Fe_2O_6H_6$. (Fuchs.)

Sol. in boiling Co, Ni, Zn, Mn, or Cu nitrates or chlorides+Aq.

Min. *Hydromagnesite*, $4MgO$, $3CO_2+4H_2O$. $+10H_2O$. Sol. in considerable amount in H_2CO_3+Aq or $MgH_2(CO_3)_2$+Aq. (Engel, C. R. **100**. 911.)

Magnesium carbonate, $MgCO_3$.

Anhydrous. Insol. in H_2O. 1 l. H_2O dissolves 106 mg. $MgCO_3$. (Chevalet, Z. anal. **8**. 91.) Sol. in 5071 pts. H_2O at 15°. (Kremers.) $MgCO_3$ combines with H_2O to form $MgCO_3+3H_2O$, and $+5H_2O$, which are less sol. in H_2O than anhydrous salt. (Engel, C. R. **101**. 814.)

For solubility in H_2CO_3+Aq, see *Magnesium hydrogen carbonate*.

Scarcely acted upon by HCl+Aq. (Senarmont.)

Min. *Magnesite.* Very sl. attacked by warm conc. HCl+Aq. 100 pts. H_2O dissolve 0·0027 pt., calculated as MgO. (Lubavin.)

$+H_2O$.

$+2H_2O$. Decomp. by suspension in H_2O into basic salt. (Engel, C. R. **100**. 911.)

$+3H_2O$. Small quantities of this salt are wholly dissolved by much H_2O. (Bineau.)

The solution contains in 100 pts. at—

0°	6·5°	8°	16°
0·15	0·153	0·155	0·179 pts. $MgCO_3+3H_2O$.

(Norgaard, **1850**.)

Decomp. by boiling H_2O into a basic insol. salt and CO_2. 100 pts. H_2O dissolve 0·1518 pt. at 19°. (Fritzsche, Pogg. **37**. 304.)

Sol. in 48 pts. H_2O, and decomp. by large amt. (Fourcroy.)

100 pts. H_2O dissolve 0·1518 pt. at 19°, or sol. in 658 pts. H_2O at 19°. (Beckurts, J. B. **1881**. 212.)

100 pts. H_2O dissolve 0·0812 pt., calculated as MgO. (Lubavin, J. russ. Soc. **24**. 389.)

Easily sol. in acids, even when dil.

Not decomp. by 1 pt. H_2SO_4+6 pts. alcohol, or by alcoholic solutions of glacial acetic, racemic, or tartaric acids, but is slowly decomp. by alcoholic solution of citric acid, or HNO_3+abs. alcohol. (Butini, **1827**.)

100 pts. NaCl+Aq (2·525 %) dissolve 0·1250 pt., calculated as MgO. (Lubavin.)

1 % Na_2CO_3+Aq, when mixed with 1 % $MgSO_4$+Aq, cause no ppt., but 1·5-2 % solutions ppt. this salt. (Brandes, **1825**.)

More sol. in NH_4Cl+Aq than $CaCO_3$. Sol. in NH_4NO_3+Aq, but less easily than in NH_4Cl+Aq.

1 l. H_2O, containing 6 % $MgSO_4$, $7H_2O$ and a little NaCl, dissolves 5 g. $MgCO_3$. (Hunt, Sill. Am. J. (2) **42**. 49.)

More sol. in cold alkali borates +Aq than in hot. (Wittstein.)

Sol. in Na citrate +Aq.

$+4H_2O$. Efflorescent.

$+5H_2O$. Two modifications. α. *Plates.* Sol. in 600 pts. H_2O at 0-7°; solution gradually separates out $MgCO_3$, $2H_2O$. H_2CO_3+Aq sat. at 3-4 atmos. pressure dissolves 9 % at 0-4°. $MgSO_4$+Aq dissolves 4 % moist salt at 3-4°, and it is easily sol. in Na_2CO_3, or $NaHCO_3$+Aq. (Norgaard.)

β. *Prisms.* More efflorescent than α. Sol. in 600 pts. H_2O but not in $MgSO_4$, or Na_2CO_3+Aq. Both forms are decomp. by boiling H_2O. (Norgaard.)

Magnesium hydrogen carbonate, $MgH_2(CO_3)_2$ (?).

Known only in solution.

1 l. H_2CO_3+Aq sat. at 1 atmos. pressure dissolves 23·5 g. $MgCO_3$. (Bineau.)

1 l. carbonic acid water dissolves 0·115 g. magnesite at 18° and 0·75 m. pressure. (Cossa, B. **2**. 697.)

1 pt. $MgCO_3$ dissolves in H_2O saturated with CO_2 at 5° and a pressure of—

1	2	3	4	5	6 atmospheres
in 161	144	134	110·7	110	76 pts.

(Merkel, Techn. J. B. **1867**. 213.)

H_2CO_3+Aq sat. at 3-4 atmos. pressure and 0-4° temp. dissolves 9 % $MgCO_3+5H_2O$. (Norgaard.)

$MgCO_3+3H_2O$ is sol. in 72·4 pts. H_2CO_3+Aq sat. at 20° and ord. pressure; 30·5 pts. H_2CO_3

+Aq sat. at 2 atmos. pressure; 26·0 pts. H_2CO_3+Aq sat. at 3 atmos. pressure; 21·1 pts. H_2CO_3+Aq sat. at 4 atmos. pressure; 17·09 pts. H_2CO_3+Aq sat. at 5 atmos. pressure. (Beckurts, J. B. **1881**. 212.)

1 l. H_2O sat. with CO_2 at p pressure and t° dissolves g. $MgCO_3$.

p atmos.	t°	g $MgCO_3$	p mm.	t°	g $MgCO_3$
1·0	19·5	27·79	751	13·4	28·45
2·1	19·5	33·11	760	19·5	25·79
3·2	19·7	37·3	762	29·3	21·95
4·7	19·0	43·5	764	46	15·7
5·6	19·2	46·2	764	62	10·4
6·2	19·2	48·51	765	70	8·1
7·5	19·5	51·2	765	82	4·9
9·0	18·7	56·59	765	91	2·4
...	...	...	765	100	0·0

(Engel and Ville, C. R. **93**. 34.)

The low figures of other observers are due to their using basic carbonates. By very careful experiments it was found that 1 l. H_2O sat. with CO_2 at 1 atmos. pressure and t° dissolved the following amts. of $MgCO_3$:

t°	g $MgCO_3$	t°	g $MgCO_3$	t°	g $MgCO_3$
3·5	35·6	18	22·1	40	22·1
12	26·5	30	15·8	50	9·5

(Engel, C. R. **100**. 444.)

Magnesium potassium carbonate, $MgK_2(CO_3)_2+4H_2O$.

Quickly decomp. by cold H_2O. (Deville, A. ch. (3) **33**. 87.)

$MgKH(CO_3)_2+4H_2O$. Insol. in H_2O, but decomp. thereby into an insol. basic Mg carbonate, and $MgH_2(CO_3)_2$ and $KHCO_3$, which dissolve. (Berzelius.)

Magnesium sodium carbonate, $MgCO_3, Na_2CO_3$.

Quickly decomp. with H_2O. (Deville, A. ch. (3) **33**. 89.)

$+15H_2O$. (Norgaard.)

Manganous carbonate, $MnCO_3$.

Permanent. Practically insol. in H_2O. Sol. in H_2CO_3+Aq and in acids generally.

Min. *Rhodochrosite.*

$+\frac{1}{2}$, or $1H_2O$. Insol. in H_2O. Sol. in acids. Sol. in H_2CO_3+Aq. 1 pt. $MnCO_3$ requires 2000 pts. H_2CO_3+Aq for solution. (Lassaigne.) Sol. in 7680 pts. H_2O, and 3840 pts. H_2O containing CO_2. (Jahn.) When freshly precipitated is sol. in NH_4 salts+Aq. (Wittstein.) Not more sol. in H_2O containing Na_2CO_3 or K_2CO_3 than in pure H_2O. (Ebelmen.) Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.) Not pptd. in presence of Na citrate. (Spiller.) Sol. in ferric salts +Aq, with evolution of CO_2 and pptn. of $Fe_2O_6H_6$. (Fuchs).

Manganous carbonate hydroxylamine, $4MnCO_3, 3NH_3O+2H_2O$.

Ppt. Sol. in acids. (Goldschmidt and Syngros, Z. anorg. **5**. 138.)

Mercurous carbonate, Hg_2CO_3.

Ppt. Decomp. by hot H_2O. Sol. in hot or warm NH_4Cl+Aq, but less easily than mercuric carbonate; less sol. in NH_4NO_3+Aq. (Brett, **1837**.)

Sl. sol. in K_2CO_3+Aq; partially sol. with decomp. in NH_4OH+Aq. (Wittstein.)

Mercuric carbonate, basic, $4HgO, CO_2$.

Can be washed with cold H_2O without decomp. (Millon, A. ch. (3) **19**. 368.)

$3HgO, CO_2$. Insol. in cold H_2O. Sol. in CO_2+Aq; sl. sol. in K_2CO_3+Aq. Easily sol. in NH_4Cl+Aq. (Berzelius.)

Nickel carbonate, basic, $3NiO, CO_2+5H_2O$.

Min. *Zaratite.* Easily sol. in HCl+Aq.

Pptd. nickel carbonate is a basic salt of varying composition. Insol. in H_2O or H_2CO_3+Aq. Sol. in acids. Sol. in $(NH_4)_2CO_3$+Aq; very sl. sol. in Na_2CO_3+Aq; sol. in warm NH_4Cl+Aq, and KCN+Aq. (Rose.)

Not pptd. in presence of Na citrate. (Spiller.)

Nickel carbonate, $NiCO_3$.

Not attacked by cold conc. HCl, or HNO_3+Aq. (Senarmont, A. ch. (3) **30**. 138.)

$+6H_2O$. Sol. in acids. (Deville, A. ch. (3) **35**. 446.)

See also **Carbonate, nickel, basic.**

Nickel potassium carbonate, $NiCO_3, K_2CO_3+4H_2O$.

Ppt. (Deville, A. ch. (3) **33**. 96.)

$NiCO_3, KHCO_3+4H_2O$. Decomp. by H_2O, but may be washed by $KHCO_3$+Aq without decomp. (Rose, Pogg. **84**. 566.)

Nickel sodium carbonate, $NiCO_3, Na_2CO_3+10H_2O$.

Ppt. (Deville.)

Palladious carbonate, $PdCO_3, 9PdO+10H_2O$.

Insol. in H_2O; partly sol. in NH_4OH+Aq; sl. sol. in Na_2CO_3+Aq; sol. in acids. (Kane, **1842**.)

Potassium carbonate, K_2CO_3.

Deliquescent. Very sol. in H_2O with evolution of heat.

Sol. in 1·05 pts. H_2O at 3°; 0·962 pt. at 6°; 0·900 pt. at 12·6°; 0·747 pt. at 26°; and 0·490 pt. at 70°. (Osann.)

Sol. in 0·92 pt. H_2O. (M. R. and P.)

Sol. in 0·922 pt. H_2O at 15°. (Gerlach.)

Sol. in 1 pt. H_2O. (Abl.)

100 pts. H_2O at 15·5° dissolve 100 pts. K_2CO_3. (Ure's Dict.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2CO_3	t°	Pts. K_2CO_3	t°	Pts. K_2CO_3
0	83·12	40	106·20	80	134·25
10	88·72	50	112·90	90	143·18
20	94·06	60	119·24	100	153·66
30	100·09	70	127·10	135	205·11

(Poggiale, A. ch. (3) **8**. 468.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2CO_3	t°	Pts. K_2CO_3	t°	Pts. K_2CO_3
0	89·4	46	119	91	148
1	94	47	120	92	149
2	97	48	120	93	150
3	100	49	121	94	151
4	102	50	121	95	151
5	104	51	122	96	152
6	105	52	122	97	153
7	106	53	123	98	154
8	107	54	124	99	155
9	108	55	124	100	156
10	109	56	125	101	157
11	109	57	125	102	158
12	109	58	126	103	159
13	110	59	127	104	160
14	110	60	127	105	161
15	110	61	128	106	162
16	111	62	128	107	163
17	111	63	129	108	164
18	111	64	130	109	166
19	111	65	130	110	167
20	112	66	131	111	168
21	112	67	132	112	169
22	112	68	132	113	171
23	112	69	133	114	172
24	112	70	133	115	173
25	113	71	134	116	175
26	113	72	135	117	176
27	113	73	135	118	178
28	113	74	136	119	179
29	114	75	137	120	181
30	114	76	137	121	182
31	114	77	138	122	184
32	114	78	139	123	185
33	115	79	139	124	187
34	115	80	140	125	188
35	115	81	141	126	190
36	115	82	141	127	191
37	116	83	142	128	193
38	116	84	143	129	195
39	116	85	144	130	196
40	117	86	144	131	198
41	117	87	145	132	200
42	117	88	146	133	201
43	118	89	147	134	203
44	118	90	147	135	205
45	119	...	...	...	...

(Mulder, Scheik. Verhandel. **1864**. 97.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
0·489	1·0045	11·748	1·1282
0·979	1·0098	12·727	1·1400
1·958	1·0198	13·706	1·1520
2·934	1·0299	14·685	1·1642
3·916	1·0401	15·664	1·1766
4·895	1·0505	16·643	1·1892
5·874	1·0611	17·622	1·2020
6·853	1·0719	18·601	1·2150
7·832	1·0829	19·580	1·2282
8·811	1·0940	20·559	1·2417
9·790	1·1052	21·538	1·2554
10·769	1·1166	22·517	1·2694

Sp. gr. of K_2CO_3+Aq at 15°—*Continued.*

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
23·496	1·2836	33·286	1·3915
24·475	1·2980	34·265	1·4030
25·454	1·3078	35·244	1·4147
26·432	1·3177	36·223	1·4265
27·412	1·3277	37·202	1·4384
28·391	1·3378	38·181	1·4504
29·360	1·3480	39·160	1·4626
30·349	1·3585	40·139	1·4750
31·328	1·3692	40·504	1·4812
32·307	1·3808	..	..

(Tünnerman.)

Sp. gr. and boiling-point of K_2CO_3+Aq.

% K_2CO_3	Sp. gr.	B.-pt.	% K_2CO_3	Sp. gr.	B.-pt.
4·7	1·06	100·56°	43·3	1·46	109·44°
9·0	1·11	100·56	45·8	1·50	111·11
13·2	1·15	101·11	48·8	1·54	112·78
16·8	1·19	101·11	52·1	1·58	114·44
20·5	1·22	101·66	56·0	1·63	116·11
24·0	1·25	102·22	60·4	1·70	117·78
27·3	1·28	102·78	65·5	1·80	119·44
30·5	1·31	103·33	71·8	1·95	122·22
33·6	1·34	104·44	79·2	2·15	125·56
36·2	1·38	105·56	88·4	2·40	129·44
39·0	1·41	107·22	100·0	2·60	137·78
41·7	1·44	108·33	..	..	..

(Dalton.)

Sp. gr. of K_2CO_3+Aq at 17·5°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
1	1·009	19	1·182	36	1·368
2	1·018	20	1·192	37	1·380
3	1·027	21	1·203	38	1·392
4	1·036	22	1·213	39	1·404
5	1·045	23	1·224	40	1·416
6	1·054	24	1·235	41	1·429
7	1·064	25	1·245	42	1·441
8	1·073	26	1·256	43	1·453
9	1·082	27	1·267	44	1·466
10	1·092	28	1·278	45	1·478
11	1·102	29	1·289	46	1·489
12	1·112	30	1·300	47	1·503
13	1·122	31	1·312	48	1·516
14	1·132	32	1·323	49	1·529
15	1·141	33	1·334	50	1·542
16	1·151	34	1·345	51	1·555
17	1·161	35	1·357	52	1·569
18	1·172	...	...	...	...

(Hager, Comm. **1883**.)

The sp. gr. increases or diminishes between 8° and 20° by a decrease or increase of temp. of 1° by the following amounts :—

% K_2CO_3	Corr.
40-50	0·0007
30-40	0·0005
20-30	0·0003
10-20	0·0002

(Hager.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
1	1·00914	28	1·27893
2	1·01829	29	1·28999
3	1·02743	30	1·30105
4	1·03658	31	1·31261
5	1·04572	32	1·32417
6	1·05513	33	1·33573
7	1·06454	34	1·34729
8	1·07396	35	1·35885
9	1·08337	36	1·37082
10	1·09278	37	1·38279
11	1·10258	38	1·39476
12	1·11238	39	1·40673
13	1·12219	40	1·41870
14	1·13199	41	1·43104
15	1·14179	42	1·44388
16	1·15200	43	1·44573
17	1·16222	44	1·46807
18	1·17243	45	1·48041
19	1·18265	46	1·49314
20	1·19286	47	1·50588
21	1·20344	48	1·51861
22	1·21402	49	1·53135
23	1·22459	50	1·54408
24	1·23517	51	1·55728
25	1·24575	52	1·57048
26	1·25681	52·024	1·57079
27	1·26787	...	...

(Gerlach, Z. anal. **8.** 279.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
5	1·0449	30	1·3002
10	1·0919	40	1·4170
20	1·1920	50	1·5428

(Kohlrausch, W. Ann. **1879.** 1.)

K_2CO_3+Aq containing 10 % K_2CO_3 boils at 100·8°
,, ,, 20 ,, ,, 102·2°
,, ,, 30 ,, ,, 104·5°
,, ,, 40 ,, ,, 108·6°
,, ,, 50 ,, ,, 115·2°
(Gerlach.)

Sat. K_2CO_3+Aq containing 158 pts. K_2CO_3 to 100 pts. H_2O forms a crust at 126°; highest temp. observed 134·9°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of K_2CO_3+Aq containing pts. K_2CO_3 to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 459); L=according to Legrand (A. ch. (2) **59.** 438).

B.-pt.	G	L	B.-pt.	G	L
101°	11·5	13	107°	61	59·6
102	22·5	22·5	108	67	65·9
103	32	31	109	73	71·9
104	40	38·8	110	78·5	77·6
105	47·5	46·1	111	83·5	83·0
106	54·5	53·1	112	88·5	88·2

B.-pt. of K_2CO_3+Aq, etc.—*Continued.*

B.-pt.	G	L	B.-pt.	G	L
113°	93·5	93·2	125°	152·5	152·2
114	98·5	98·0	126	158	157·3
115	103·5	102·8	127	163·5	162·5
116	108·5	107·5	128	169·5	167·7
117	113·5	112·3	129	175·5	172·9
118	117·5	117·1	130	181·5	178·1
119	122·5	122·0	131	187·5	183·4
120	127·5	127·0	132	193·5	188·8
121	132·5	132·0	133	199·5	194·2
122	137·5	137·0	133·3	202·5	...
123	142·5	142·0	134	...	199·6
124	147·5	147·1	135	...	205·0

When K_2CO_3+Aq is sat. with NH_3, two layers form. When K_2CO_3 is added to NH_4OH +Aq, it dissolves with formation of two layers and evolution of NH_3. The same takes place also when sat. K_2CO_3+Aq and NH_4OH+Aq are brought together. (Girard, Bull. Soc. (2) **43.** 552.)

Sol. in 9 pts. alcohol of 17° B. Insol. in absolute alcohol.

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol. Not decomp. by 1 pt. HNO_3+6 pts. absolute alcohol. Not decomp. by an alcoholic solution of HCl, oxalic, racemic, tartaric, or glacial acetic acids, but is decomp. by alcoholic solution of citric acid.

Sol. in phenol.

Sol. in 13·5 pts. glycerine of 1·225 sp. gr. (Vogel, N. Repert. **16.** 557.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. **6.** 184.)

+H_2O.

+$1\frac{1}{2}H_2O$. Very deliquescent. (Pohl.)

Deliquescent only in very moist air. (Städeler.)

Sol. in H_2O with evolution of heat. (Pohl.)

Sol. at 17·6° with absorption of heat, at 32° with evolution of heat, and at 25° with neither absorption nor evolution of heat. (Berthelot, C. R. **78.** 1722.)

+$2H_2O$. Salt usually given as containing $1\frac{1}{2}H_2O$ contains $2H_2O$. (Gerlach, Z. anal. **26.** 460.)

+$4H_2O$. Not deliquescent in closed vessels. (Gerlach, *l.c.*)

Potassium hydrogen carbonate, $KHCO_3$.

Not deliquescent.

Sol. in 3·5 pts. H_2O at 15°. (Redwood.) Sol. in 4 pts. H_2O at moderate temperatures. (Bergmann.) Sol. in 0·8333 pt. boiling H_2O (Pelletier); in 4 pts. cold, and 1·2 pts. boiling H_2O (M. R. and P.'s Pharm.). Sol. in 4 pts. H_2O at 18·75°. (Abl.) 100 pts. H_2O at 15·5° dissolve 30 pts. and at 100°, 83 pts. (Ure's Dict.)

100 pts. H_2O at 10-11·2° dissolve 26·1 pts. $KHCO_3$, and the sp. gr. of solution is 1·1536. (Anthon, Dingl. **161.** 216.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°	
19·61	23·23	26·91	30·57	pts. $KHCO_3$,
40°	50°	60°	70°	
34·15	37·92	41·35	45·24	pts. $KHCO_3$.

(Poggiale, A. ch. (3) **8.** 468.)

100 pts. H_2O dissolve pts. $KHCO_3$ at t°.

t°	Pts. $KHCO_3$	t°	Pts. $KHCO_3$
0	22·4	40	45·2
20	33·2	60	46·4

(Dibbits, J. pr. (2) **10**. 417.)

Sp. gr. of $KHCO_3$+Aq at 15° containing 5 % $KHCO_3$=1·0328 ; containing 10 % $KHCO_3$ =1·0674. (Kohlrausch, Z. anal. **28**. 472.)

Sol. in 1200 pts. boiling alcohol. (Berthollet.) Insol. in alcohol. (Dumas.)

100 pts. H_2O dissolve 19·3 pts. $KHCO_3$ and 8·3 pts. $NaHCO_3$ if the sat. solution of latter is sat. with former ; and 26·1 pts. $KHCO_3$ and 6·0 pts. $NaHCO_3$, if the sat. solution of the former is sat. with the latter, all at 10°. (Mulder, J. B. **1866**. 67.)

Insol. in sat. K_2CO_3+Aq. (Engel, C. R. **102**. 365.)

Potassium carbonate, acid, $2K_2O$, $3CO_2$.

Deliquescent. Insol. in alcohol. (Berthollet.) Tables of solubility in H_2O are given by Poggiale (A. ch. (3) **8**. 468). Does not exist. (Rose, Kraut, etc.)

Potassium samarium carbonate, K_2CO_3, $Sm_2(CO_3)_3+12H_2O$.

(Cleve.)

Potassium silver carbonate, $KAgCO_3$.

Decomp. by H_2O. (de Schulten, C. R. **105**. 811.)

Potassium sodium carbonate, $KNaCO_3+6H_2O$.

Slightly efflorescent. Sol. in 0·75 pt. H_2O at 12·5° ; in 0·54 pt. H_2O at 15°.

Sat. solution at 15° has sp. gr.=1·366. (Stolba, J. pr. **94**. 406.)

Decomp. by recrystallising from H_2O, but crystallises undecomposed from sat. K_2CO_3+Aq.

K_2CO_3, $2Na_2CO_3+18H_2O$. Sl. efflorescent. Very sol. in H_2O. (Marignac.)

Potassium stannous carbonate, K_2CO_3, $2SnCO_3+2H_2O$.

Decomp. by H_2O. (Deville.)

Potassium uranyl carbonate, $2K_2CO_3,(UO_2)CO_3$.

Sol. without decomp. in 13·5 pts. H_2O at 15°, and in somewhat less warm H_2O. Sol. in boiling H_2O with decomp.

More sol. in K_2CO_3, or $KHCO_3$+Aq than in H_2O. (Rose.)

Insol. in alcohol. (Ebelmen, A. ch. (3) **5**. 189.)

Potassium zinc carbonate, $4K_2O, 6ZnO, 11CO_2+8H_2O$.

Can be washed with cold H_2O without decomp. (Deville, A. ch. (3) **33**. 99.)

Rubidium carbonate, Rb_2CO_3.

Very deliquescent, and sol. in H_2O. 100 pts. absolute alcohol dissolve 0·74 pt. Rb_2CO_3. (Bunsen.)

Rubidium hydrogen carbonate, $RbHCO_3$.

Not deliquescent. Easily sol. in H_2O. (Bunsen.)

Samarium carbonate, $Sm_2(CO_3)_3+3H_2O$.

Insol. in H_2O. (Cleve, Bull. Soc. (2) **43**. 168.)

Samarium sodium carbonate, $Sm_2(CO_3)_3,Na_2CO_3+16H_2O$.

Ppt. (Cleve.)

Silver carbonate, Ag_2CO_3.

Somewhat sol. in H_2O. Sol. in 31,978 pts. H_2O at 15°. (Kremers, Pogg. **85**. 248.) 1 g. Ag_2CO_3 dissolves in 2 l. boiling H_2O. (Joulin, A. ch. (4) **30**. 260.) Insol. in H_2CO_3+Aq. (Bergman.) Sol. in 961 pts. H_2CO_3+Aq. (Lassaigne.) 1 l. sat. H_2CO_3+Aq dissolves 0·846 g. Ag_2CO_3 at 15°. (Johnson, C. N. **54**. 75.)

Sol. in $(NH_4)_2CO_3$+Aq or NH_4OH+Aq ; sl. sol. in K_2CO_3+Aq. (Wittstein.) Easily sol. in $Na_2S_2O_3$+Aq. (Herschel, **1819**.) Sol. in hot NH_4Cl+Aq, and sl. sol. in NH_4NO_3+Aq. (Brett, **1837**.) Not pptd. in presence of Na citrate. (Spiller.) Decomp. by HCl+Aq, and chlorides +Aq.

Insol. in alcohol.

Silver carbonate ammonia.

Easily sol. in H_2O. Sol. in NH_4OH+Aq, from which it is precipitated by absolute alcohol. (Berzelius.)

Ag_2CO_3, $4NH_3$. Ppt. Insol. in alcohol. (Keen, C. N. **31**. 231.)

Sodium carbonate, Na_2CO_3.

Anhydrous. Sol. in H_2O with evolution of heat.

Sol. in 5·967 pts. H_2O at 15°. (Fresenius.)

100 pts. H_2O at 14·6° dissolve 7·74 pts. Na_2CO_3, or 20·64 pts. $Na_2CO_3,10H_2O$ is sol. in rather less than 1 pt. boiling H_2O. (Thomson, **1831**.)

Sol. in 2 pts. H_2O. (Bergman.)

Sol. in 2 pts. H_2O at 18·75°. (Abl.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2CO_3	Pts. Na_2CO_3 $+10H_2O$	t°	Pts. Na_2CO_3	Pts. Na_2CO_3 $+10H_2O$
0	7·08	21·52	25	35·90	171·33
10	16·66	61·98	30	35·90	241·57
20	30·83	123·12	104·6	48·50	420·68

(Poggiale, A. ch. (3) **8**. 468.)

Possesses four different degrees of solubility, according to different states of molecular constitution and degrees of hydration. (Löwel, A. ch. (3) **44**. 330.)

Little more sol. at 34-38° than at 104°, but maximum of solubility is probably at 15°. (Löwel.)

Solubility of Na_2CO_3, $Na_2CO_3+10H_2O$, $Na_2CO_3+7H_2O$ (*a*), and $Na_2CO_3+7H_2O$ (*b*) in H_2O.

t°	Sat. solution of $Na_2CO_3+10H_2O$ contains—		Sat. solution of $Na_2CO_3+7H_2O$ (*b*) contains—			Sat. solution of $Na_2CO_3+7H_2O$ (*a*) contains—		
	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+7H_2O$ (*b*) in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+7H_2O$ (*a*) in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O
0	6·97	21·33	20·39	58·93	84·28	31·93	112·94	188·37
10	12·06	40·94	26·33	83·94	128·57	37·85	150·77	286·13
15	16·20	63·20	29·58	100·00	160·51	41·55	179·90	381·29
20	21·71	92·82	38·55	122·25	210·58	45·79	220·20	556·71
25	28·50	149·13	38·07	152·36	290·91	...	...	...
30	37·24	273·64	43·45	196·93	447·93	...	...	...
38	51·67	1142·17	...	...	...	...	...	...
104	45·47	539·63	...	...	...	...	...	...

(Löwel, A. ch. (3) **33**. 382.)

100 pts. H_2O at 14° dissolve 60·4 pts. $Na_2CO_3+10H_2O$; at 36°, 833 pts.; at 104°, 445 pts. Solubility increases to 36°, then diminishes. (Payen, A. ch. (3) **43**. 233.)

There are apparently two maxima of solubility; the one occurring at 15°, or even lower, as warm solutions cool; the other at 34-38°, when cold solutions are warmed. (Payen, A.ch. (3) **44**. 330.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3
0	7·1	35	46·2	71	46·2
1	7·5	36	46·2	72	46·2
2	7·8	37	46·2	73	46·2
3	8·4	38	46·2	74	46·2
4	8·9	39	46·2	75	46·2
5	9·5	40	46·2	76	46·2
6	10·0	41	46·2	77	46·2
7	10·6	42	46·2	78	46·2
8	11·2	43	46·2	79	46·2
9	11·9	44	46·2	80	46·1
10	12·6	45	46·2	81	46·1
11	13·3	46	46·2	82	46·1
12	14·0	47	46·2	83	46·0
13	14·8	48	46·2	84	46·0
14	15·6	49	46·2	85	45·9
15	16·5	50	46·2	86	45·9
16	17·4	51	46·2	87	45·8
17	18·3	52	46·2	88	45·8
18	19·3	53	46·2	89	45·8
19	20·3	54	46·2	90	45·7
20	21·4	55	46·2	91	45·7
21	22·6	56	46·2	92	45·7
22	23·8	57	46·2	93	45·6
23	25·1	58	46·2	94	45·6
24	26·5	59	46·2	95	45·6
25	28·0	60	46·2	96	45·6
26	29·7	61	46·2	97	45·5
27	31·6	62	46·2	98	45·5
28	33·6	63	46·2	99	45·5
29	35·8	64	46·2	100	45·4
30	38·1	65	46·2	101	45·4
31	41·4	66	46·2	102	45·3
32	46·2	67	46·2	103	45·3
32·5	59·0	68	46·2	104	45·2
33	46·2	69	46·2	105	45·1
34	46·2	70	46·2	...	...

(Mulder, Scheik. Verhandel. **1864**. 129.)

Liable to form supersaturated solutions.

Supersat. Na_2CO_3+Aq (2 pts. Na_2CO_3, $10H_2O$: 1 pt. H_2O) may be kept in a flask closed with cotton wool. (Schröder.)

When supersat. Na_2CO_3+Aq is exposed to low temperatures, the $10H_2O$ salt crystallises out; but under other circumstances two other salts are formed, each containing $7H_2O$; one is four times as sol. at 10° as the $10H_2O$ salt, and the other twice as sol. See above. (Löwel, A. ch. (3) **33**. 337.)

Sp. gr. of Na_2CO_3+Aq at 15°.

% Na_2CO_3	Sp. gr.	% Na_2CO_3	Sp. gr.
0·372	1·0040	7·812	1·0892
0·744	1·0081	8·184	1·0937
1·116	1·0121	8·556	1·0982
1·488	1·0163	8·928	1·1028
1·850	1·0204	9·300	1·1074
2·232	1·0245	9·672	1·1120
2·504	1·0286	10·044	1·1167
2·976	1·0327	10·416	1·1214
3·348	1·0368	10·788	1·1261
3·720	1·0410	11·160	1·1308
4·090	1·0452	11·532	1·1356
4·464	1·0494	11·904	1·1404
4·836	1·0537	12·276	1·1452
5·208	1·0576	12·648	1·1500
5·580	1·0625	13·020	1·1549
5·972	1·0669	13·392	1·1598
6·324	1·0713	13·764	1·1648
6·396	1·0757	14·136	1·1698
6·768	1·0802	14·508	1·1748
7·440	1·0847	14·880	1·1816

(Tünnerman.)

Sp. gr. of Na_2CO_3+Aq at 15°.

%	Sp. gr. if % is Na_2CO_3	Sp. gr. if % is $Na_2CO_3+10H_2O$	%	Sp. gr. if % is $Na_2CO_3+10H_2O$
1	1·0105	1·004	15	1·058
2	1·0210	1·008	16	1·062
3	1·0315	1·012	17	1·066
4	1·0420	1·016	18	1·070
5	1·0525	1·020	19	1·074
6	1·0631	1·023	20	1·078
7	1·0737	1·027	21	1·082
8	1·0843	1·031	22	1·086
9	1·0950	1·035	23	1·090
10	1·1057	1·039	24	1·094
11	1·1165	1·043	25	1·099
12	1·1274	1·047	26	1·103
13	1·1384	1·050	27	1·106
14	1·1495	1·054	28	1·110

Sp. gr. of Na_2CO_3+Aq at 15°—*Continued.*

%	Sp. gr. if % is Na_2CO_3 +$10H_2O$	%	Sp. gr. if % is Na_2CO_3 +$10H_2O$
29	1·114	34	1·135
30	1·119	35	1·139
31	1·123	36	1·143
32	1·126	37	1·147
33	1·130	38	1·150

(Gerlach, Z. anal. **8.** 279.)

Sp. gr. of Na_2CO_3+Aq at 17·5°.

% Na_2CO_3	% Na_2CO_3 +$10H_2O$	Sp. gr.	% Na_2CO_3	% Na_2CO_3 +$10H_2O$	Sp. gr.
1	2·70	1·010	9	24·30	1·095
2	5·40	1·020	10	27·00	1·105
3	8·10	1·031	11	29·70	1·116
4	10·18	1·041	12	32·40	1·127
5	13·50	1·052	13	35·10	1·137
6	16·20	1·063	14	37·80	1·148
7	18·90	1·073	15	40·50	1·157
8	21·60	1·084	...	...	...

(Hager.)

Sp. gr. of Na_2CO_3+Aq increases or diminishes by a change of temperature of 1° by the following amounts—

Corr.	% Na_2CO_3
0·0004	13-15
0·00033	8-12
0·00026	3-7

(Hager, Comm. **1883.**)

Sp. gr. of conc. Na_2CO_3+Aq at 30°.

Sp. gr.	% Na_2CO_3	g. Na_2CO_3 in 1 l.	Sp. gr.	% Na_2CO_3	g. Na_2CO_3 in 1 l.
1·310	28·13	368·5	1·220	20·47	249·7
1·300	27·30	354·9	1·210	19·61	237·3
1·290	26·46	341·3	1·200	18·76	225·1
1·280	25·62	327·9	1·190	17·90	214·0
1·270	24·78	314·7	1·180	17·04	201·1
1·260	23·93	301·5	1·170	16·18	189·3
1·250	23·08	288·5	1·160	15·32	177·7
1·240	22·21	275·4	1·150	14·47	166·4
1·230	21·33	262·3	1·140	13·62	155·3

(Lunge, Chem. Ind. **1882.** 320.)

Sp. gr. of Na_2CO_3+Aq at 23°.

% Na_2CO_3 +$10H_2O$.	% Na_2CO_3.	Sp. gr.	% Na_2CO_3 +$10H_2O$.	% Na_2CO_3.	Sp. gr.
1	0·370	1·0038	26	9·635	1·1035
2	0·741	1·0076	27	10·005	1·1076
3	1·112	1·0114	28	10·376	1·1117
4	1·482	1·0153	29	10·746	1·1158
5	1·853	1·0192	30	11·118	1·1200
6	2·223	1·0231	31	11·488	1·1242
7	2·594	1·0271	32	11·859	1·1284
8	2·965	1·0309	33	12·230	1·1326
9	3·335	1·0348	34	12·600	1·1368
10	3·706	1·0388	35	12·971	1·1410
11	4·076	1·0428	36	13·341	1·1452
12	4·447	1·0468	37	13·712	1·1494
13	4·817	1·0508	38	14·082	1·1536
14	5·188	1·0548	39	14·530	1·1578
15	5·558	1·0588	40	14·824	1·1620
16	5·929	1·0628	41	15·195	1·1662
17	6·299	1·0668	42	15·556	1·1704
18	6·670	1·0708	43	15·936	1·1746
19	7·041	1·0748	44	16·307	1·1788
20	7·412	1·0789	45	16·677	1·1830
21	7·782	1·0836	46	17·048	1·1873
22	8·153	1·0871	47	17·418	1·1916
23	8·523	1·0912	48	17·789	1·1959
24	8·894	1·0953	49	18·159	1·2002
25	9·264	1·0994	50	18·530	1·2045

(Schiff, A. **113.** 186.)

Sp. gr. of Na_2CO_3+Aq at 23·3°. a=number of grms. × $\frac{1}{2}$ mol. wt., dissolved in 1000 grms. H_2O ; b=sp. gr. if a=$Na_2CO_3,10H_2O$ ($\frac{1}{2}$ mol. wt.=143) ; c=sp. gr. if a=Na_2CO_3 ($\frac{1}{2}$ mol. wt.=53).

a	b	c	a	b	c
1	1·048	1·052	5	1·163	1·226
2	1·086	1·100	6	1·182	...
3	1·117	1·145	7	1·198	...
4	1·142	1·187	...	...	...

(Favre and Valson, C.R. **79.** 968.)

Sp. gr. of Na_2CO_3+Aq at 18°.

% Na_2CO_3.	Sp. gr.	% Na_2CO_3.	Sp. gr.
5	1·0511	15	1·1590
10	1·1044	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Na_2CO_3+Aq containing 5 % Na_2CO_3 boils at 100·5° ; 10 % Na_2CO_3, at 101·1° ; 15 % Na_2CO_3, at 101·8°. (Gerlach.)

Sat. solution boils at 104·4° (Griffiths, **1825**) ; 106° (Kremers) ; 104° (Payen).

Sat. solution forms a crust at 104·1°, and contains 42·2 pts. Na_2CO_3 to 100 pts. H_2O ; highest temperature observed, 105°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of Na_2CO_3+Aq containing pts. Na_2CO_3 to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 458); L=according to Legrand (A. ch. (2) **59.** 426).

B.-pt.	G	L	B.-pt.	G	L
100·5°	5·2	7·5	103·5°	36·2	41·0
101·0	10·4	14·4	104·0	41·2	44·7
101·5	15·6	20·8	104·5	46·2	47·9
100·2	20·8	26·7	104·63	...	48·5
102·5	26·0	32·0	105·0	51·2	...
103·0	31·1	36·8	...	...	...

Less sol. in dil. NH_4OH+Aq than in H_2O. (Fresenius.)

Solubility in NaCl+Aq. 100 pts. H_2O dissolve pts. NaCl and pts. Na_2CO_3, $10H_2O$, when that salt is in excess at 15°.

Pts. NaCl	Pts. Na_2CO_3, $10H_2O$	Pts. NaCl	Pts. Na_2CO_3, $10H_2O$
0·00	61·42	23·70	39·06
4·03	53·86	27·93	39·73
8·02	48·00	31·65	41·44
12·02	43·78	35·46	43·77
16·05	40·96	sat.	
19·82	39·46	37·27	45·32

Solubility of anhydrous Na_2CO_3 in 100 pts. NaCl+Aq containing % NaCl at 15°.

% NaCl	Pts. Na_2CO_3	% NaCl	Pts. Na_2CO_3
0	16·408	12	10·488
1	15·717	13	10·244
2	15·060	14	10·041
3	14·438	15	9·880
4	13·851	16	9·762
5	13·299	17	9·686
6	12·783	18	9·655
7	12·305	19	9·667
8	11·864	20	9·725
9	11·461	21	9·828
10	11·097	22	9·997
11	10·773	...	...

(Reich, W. A. B. **99, 2b.** 433.)

Insol. in alcohol. (Fresenius.)

Sl. sol. in absolute alcohol; apparently insol. in an alcoholic solution of soap. (Duffy, Chem. Soc. **5.** 305.)

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol.

Not decomp. by alcoholic solutions of racemic, tartaric, or glacial acetic acids; slowly decomp. by HNO_3+absolute alcohol.

Insol. in acetone. (Krug and M'Elroy.)

+H_2O. Takes up H_2O from the air. Less sol. in H_2O at 104° than at 38°; at 15-20°, 100 pts. H_2O dissolve 52·4 pts. of this salt, calculated as Na_2CO_3. Insol. in alcohol. (Löwel.)

Min. *Thermonatrite.*

+$3H_2O$. (Schickendantz, A. **155.** 359.)

+$5H_2O$. (Persoz, Pogg. **32.** 303.)

Not efflorescent. Sol. in H_2O.

+$6H_2O$. (Mitscherlich, Pogg. **8.** 441.)

+$7H_2O$. Efflorescent. Two salts, $7H_2O$ (*b*) (=with $8H_2O$ of Thomson), and $7H_2O$ (*a*). See page 92, for solubility.

+$10H_2O$. Efflorescent. Sol. in 1·05 pts. H_2O at 23°, and sat. solution has sp. gr. 1·1995. (Schiff, A. **109.** 326.)

Melts in crystal H_2O at 34°. (Tilden, Chem. Soc. **45.** 409.)

See above for further data.

+$15H_2O$. (Jacquelain, A. **80.** 241.)

Sodium hydrogen carbonate, $NaHCO_3$.

100 pts. cold H_2O dissolve 7·7 pts. $NaHCO_3$. (Rose, Schw. J. **6.** 52.)

100 pts. H_2O at 11·25° dissolve 8·27 pts. $NaHCO_3$ to form solution of 1·0613 sp. gr. (Anthon, Dingl. **161.** 216.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°	
8·95	10·04	11·15	12·24	pts. $NaHCO_3$,
40°	50°	60°	70°	
13·35	14·45	15·57	16·69	pts. $NaHCO_3$.

(Poggiale, A. ch. (3) **8.** 468.)

100 pts. H_2O dissolve pts. $NaHCO_3$ at t°.

t°	Pts. $NaHCO_3$	t°	Pts. $NaHCO_3$	t°	Pts. $NaHCO_3$
0	6·90	21	9·75	42	13·05
1	7·00	22	9·90	43	13·20
2	7·10	23	10·05	44	13·40
3	7·20	24	10·20	45	13·55
4	7·35	25	10·35	46	13·75
5	7·45	26	10·50	47	13·90
6	7·60	27	10·65	48	14·10
7	7·70	28	10·80	49	14·30
8	7·85	29	10·95	50	14·45
9	8·00	30	11·10	51	14·65
10	8·15	31	11·25	52	14·85
11	8·25	32	11·40	53	15·00
12	8·40	33	11·55	54	15·20
13	8·55	34	11·70	55	15·40
14	8·70	35	11·90	56	15·60
15	8·85	36	12·05	57	15·80
16	9·00	37	12·20	58	16·00
17	9·15	38	12·35	59	16·20
18	9·30	39	12·50	60	16·40
19	9·40	40	12·70	...	...
20	9·60	41	12·90	...	...

(Dibbits, J. pr. (2) **10.** 417.)

$NaHCO_3$+Aq sat. at 16° has sp. gr. = 1·06904. (Stolba.)

Nearly insol. in sat. NaCl, or Na_2SO_4+Aq. (Balmain, B. **5.** 121.)

Sodium *di*hydrogen *tri*carbonate, $Na_4H_2(CO_3)_3$ +$3H_2O$.

More sol. than $NaHCO_3$; less sol. than Na_2CO_3 in H_2O. (Rose, Pogg. **34.** 160.)

100 pts. H_2O dissolve, calculated as $2Na_2O, 3CO_2$—

at 0°	12·63 pts.	at 60°	29·68 pts.
.. 10°	15·50 ,,	,, 70°	32·55 ,,
.. 20°	18·30 ,,	,, 80°	35·8 ,,
.. 30°	21·15 ,,	,, 90°	38·63 ,,
.. 40°	23·95 ,,	,, 100°	41·59 ,,
.. 50°	26·78 ,,		

(Poggiale, A. ch. (3) **8.** 468.)

Min. *Trona*, *Urao*. *See* $Na_3H(CO_3)_2+2H_2O$.

***Trisodium* hydrogen carbonate**, $Na_3H(CO_3)_2+2H_2O$.

Sol. in H_2O.

True formula of "Trona" and "Urao." (Zepharovich, Zeit. Kryst. **13.** 135; de Mondesir, C. R. **104.** 1505.)

Sodium thorium carbonate, $3Na_2CO_3, Th(CO_3)_2+12H_2O$.

Decomp. by H_2O. (Cleve.)

Sodium uranyl carbonate, $2Na_2CO_3, (UO_2)CO_3$.

Slowly sol. in H_2O. Solution sat. at 15° has sp. gr. = 1·161. (Anthon, Dingl. **156.** 207.)

Sodium yttrium carbonate, $Na_2CO_3, Y_2(CO_3)_3+4H_2O$.

Ppt. Not decomp. by cold H_2O. (Cleve.)

Sodium zinc carbonate, $3Na_2O, 8ZnO, 11CO_2+8H_2O=3Na_2CO_3, 8ZnCO_3+8H_2O$.

Sl. decomp. by pure H_2O. (Wöhler.)

Less easily decomp. by H_2O than most double carbonates. (Deville, A. ch. (3) **33.** 101.)

Strontium carbonate, $SrCO_3$.

Sol. in 18,045 pts. H_2O at ordinary temp. (Fresenius.)

Sol. in 12,522 pts. H_2O at 15°. (Kremers, Pogg. **85.** 247.)

Sol. in 33,000 pts. H_2O. (Bineau, C. R. **41.** 511.)

Less sol. in H_2O than $SrSO_4$. (Dulong.)

Sol. in 1536 pts. boiling H_2O. (Hope, Edinb. Trans. **4.** 5.)

Calculated from electrical conductivity of $SrCO_3$ + Aq, $SrCO_3$ is sol. in 121,760 pts. H_2O at 8·8° and 91,468 pts. at 24·3° (Hollemann, Z. phys. Ch. **12.** 130); 1 l. H_2O dissolves 11 mg. $SrCO_3$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Sol. in 833 pts. H_2CO_3 + Aq at 10°. (Gmelin.)

Sol. in 56,545 pts. H_2O containing NH_4OH and $(NH_4)_2CO_3$.

Quite sol. in NH_4Cl + Aq or NH_4NO_3 + Aq, but reprecipitated on addition of NH_4OH and $(NH_4)_2CO_3$ + Aq. (Fresenius.)

Partially decomp. by boiling with aqueous solutions of K_2SO_4, Na_2SO_4, $CaSO_4$, $(NH_4)_2SO_4$, $MgSO_4$, Na_2HPO_4, $(NH_4)_2HPO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, $Na_2B_4O_7$, Na_2AsO_2, K_2AsO_2, $K_2C_2O_4$, $Na_2C_2O_4$, NaF, and K_2CrO_4. Decomp. is complete with the NH_4 salts. (Dulong, A. ch. **82.** 286.)

Sl. decomp. by Na_2SO_4, or K_2SO_4 + Aq. (Persoz.)

Easily sol. in NH_4 chloride, nitrate, or succinate + Aq, but less so than $BaCO_3$. (Fresenius.) Sol. in ferric salts + Aq, with pptn. of $Fe_2O_6H_6$. Sol. in Na citrate + Aq. (Spiller.) Sl. decomp. by K_2SO_4, or Na_2SO_4 + Aq. (Persoz.) Not decomp. by a mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, nor by alcoholic solutions of tartaric, racemic, citric, or glacial acetic acids; immediately decomp. by HNO_3 + absolute alcohol, or $H_2C_2O_4$ + abs. alcohol.

Min. *Strontianite.*

Strontium hydrogen carbonate.

$SrCO_3$ is sol. in 850 pts. of a sat. solution of CO_2 in H_2O.

Terbium carbonate.

Precipitate. Less sol. in $(NH_4)_2CO_3$ + Aq than yttrium carbonate.

Thallous carbonate, Tl_2CO_3.

100 pts. H_2O dissolve pts. Tl_2CO_3 (C = according to Crookes; L = according to Lamy) at—

15·5°	18°	62°	100°	100·8°
4·2	5·23	12·85	27·2	22·4 pts. Tl_2CO_3.
C	L	L	C	L

Insol. in absolute alcohol (L), and ether (C).

Thallous carbonate acid, $Tl_2O, 2CO_2$.

Rather easily sol. in cold H_2O. (Carstanjen.)

Thallium carbonate platinocyanide, $Tl_2CO_3, Tl_2Pt(CN)_4$.

Sl. sol. in hot; insol. in cold H_2O. (Friswell, Chem. Soc. (2) **9.** 461.)

Thorium carbonate, basic, $2ThO_2, CO_2+3H_2O$.

Insol. in CO_2 + Aq, but sol. in excess of alkali carbonates + Aq, if conc.

Stannous carbonate, $2SnO, CO_2$.

Easily decomp. on air; insol. in H_2O or H_2CO_3 + Aq. (Deville, A. ch. (3) **35.** 448.)

Yttrium carbonate, $Y_2(CO_3)_3+3H_2O$.

Insol. in H_2O; very sl. sol. in H_2CO_3 + Aq. Sol. in SO_2 + Aq and all mineral acids. Sol. in NH_4 salts, and alkali carbonates + Aq to some extent. More sol. in $(NH_4)_2CO_3$ + Aq than in K_2CO_3 + Aq. (Berlin.) More sol. in $(NH_4)_2CO_3$ + Aq than cerium, but 5 or 6 times less than glucinum carbonate. (Vauquelin.) Sol. in large excess of $KHCO_3$ + Aq. (Rose.) Slowly sol. in NH_4 salts + Aq. (Berzelius.)

Zinc carbonates, basic, $8ZnO, CO_2+2H_2O$; $5ZnO, 2CO_2+3$, or $7H_2O$; $3ZnO, CO_2+H_2O$; $11ZnO, 4CO_2+14H_2O$; $14ZnO, 5CO_2+9H_2O$; $2ZnO, CO_2+H_2O$; $8ZnO, 3CO_2+5H_2O$, etc.

All ppts. formed from Zn salts and carbonates + Aq. Sol. in 2000-3000 pts. cold H_2O, separates out on heating and does not redissolve on cooling. (Schindler.) Sol. in 20,895 pts. H_2O at 15°. (Kremers, Pogg. **85.** 248.) Sol. in 44,600 pts. H_2O at ord. temp. (Fresenius.)

Sol. in 1428 pts. sat. H_2CO_3 + Aq. (Lassaigne.) Sol. in 189 pts. H_2CO_3 + Aq sat. at 4-6 atmos. (Wagner, Z. anal. **6.** 107.) Easily sol. in KOH, NaOH, NH_4OH, $(NH_4)_2CO_3$ + Aq, and in acids. Somewhat sol. in alkali bicarbonates and NH_4 salts + Aq. (Fresenius.) Sol.

in hot (Fuchs), also cold (Brett, **1837**) NH_4Cl + Aq ; less sol. in NH_4NO_3 + Aq. (Brett.)

Sol. in all NH_4 salts + Aq excepting $(NH_4)_2S$ + Aq. (Terreil, Bull. Soc. (2) **9**. 441.)

Insol. in Na_2CO_3, or K_2CO_3 + Aq. Sol. in ferric salts + Aq with pptn. of $Fe_2O_6H_6$. (Fuchs, **1831**.)

$3ZnO, CO_2 + 2H_2O$. Min. *Zinc bloom, Hydrozincite.*

$ZnCO_3, 3ZnO_2H_2$. Min. *Auricalcite.*

Zinc carbonate, $ZnCO_3$.

Sol. in acids, KOH + Aq, and NH_4 salts + Aq. Sol. in H_2CO_3 + Aq.

Min. *Calamine, Smithsonite.*

+ H_2O.

Zinc carbonate ammonia, $ZnCO_3, NH_3$.

Slowly decomp. by H_2O, but not on the air, or by boiling with alcohol. (Favre, A. ch. (3) **10**. 474.)

Zinc carbonate hydroxylamine, $ZnCO_3, 2NH_3O$.

Insol. in H_2O. Decomp. by acids. (Goldschmidt and Syngros, Z. anorg. **5**. 129.)

Zirconium carbonate, $3ZrO_2, CO_2 + 6H_2O$.

Decomp. by hot H_2O, all CO_2 being given off. (Hermann.)

Sol. in alkali carbonates + Aq.

Carbonic anhydride, CO_2.

See **Carbon *di*oxide.**

Carbonyl chloride, $COCl_2$.

Phosgene. Cold H_2O dissolves 1-2 vols. $COCl_2$ gas with slow decomposition. Alcohol decomp. immediately. Immediately absorbed by KOH, or NH_4OH + Aq. Very sol. in glacial $HC_2H_3O_2$, benzene, and most liquid hydrocarbons. (Berthelot, Bull. Soc. (2) **13**. 14.)

Sol. in SCl_2. 1 vol. $AsCl_3$ absorbs 10 vols. $COCl_2$.

Carbonyl platinous chloride, $2COCl_2, PtCl_2$.

Sl. deliquescent. Easily sol. in H_2O without decomp. ; sl. sol. in alcohol. Almost insol. in CCl_4. (Pullinger, Chem. Soc. **59**. 600.)

Carbonyl ferrocyanhydric acid, $H_3Fe(CO)(CN)_5$.

Very sol. in H_2O ; decomp. on heating. (Müller, A. ch. (6) **17**. 94.)

Cobalt carbonyl ferrocyanide.

Sl. sol. in H_2O ; very sol. in dil. HNO_3 + Aq. (M.)

Cupric carbonyl ferrocyanide, $Cu_3[Fe(CO)(CN)_5]_2$.

Insol. in H_2O, H_2SO_4, or dil. HNO_3 + Aq. (M.)

Ferric carbonyl ferrocyanide, $FeFeCO(CN)_5$.

Insol. in H_2O. Sol. in $H_2C_2O_4$ + Aq. Insol. in acetic, lactic, succinic, tartaric, and citric acids + Aq, but easily sol. in the neutral salts of those acids. Insol. in KCl, or KNO_3 + Aq, but sensibly sol. in Na_2HPO_4 + Aq. Insol. even on warming in very dil. H_2SO_4, or H_3PO_4 + Aq. (Müller.)

Potassium carbonyl ferrocyanide, $K_3Fe(CO)(CN)_5 + 3\frac{1}{2}H_2O$.

100 pts. H_2O dissolve 148 pts. at 16°. (Müller, C. R. **104**. 992.)

Silver carbonyl ferrocyanide, $Ag_3Fe(CO)(CN)_5$.

Insol. in H_2O ; sl. sol. in dil. H_2SO_4, HCl, or HNO_3 + Aq ; scarcely attacked by conc. $HC_2H_3O_2$ + Aq. (Müller.)

Sodium carbonyl ferrocyanide, $Na_3Fe(CO)(CN)_5 + 6H_2O$.

Sol. in H_2O. (Müller.)

Uranyl carbonyl ferrocyanide, $(UO_2)_3[FeCO(CN)_5]_2 + 5H_2O$.

Sl. sol. in H_2O, but more easily if H_2O is acidified with $HC_2H_3O_2$.

Carbonyl platinous bromide, $CO, PtBr_2$.

Sol. in H_2O with almost instant decomp. Sol. in absolute alcohol. (Pullinger, Chem. Soc. **59**. 603.)

Quite easily sol. in hot C_6H_6, insol. in ligroine, and can be crystallised from CCl_4. Very easily sol. in HBr + Aq. (Mylius and Förster, B. **24**. 2432.)

***Mono*carbonyl platinous chloride**, $CO, PtCl_2$.

Decomp. by H_2O and alcohol ; sol. in hot CCl_4. (Schützenberger, A. ch. (4) **15**. 100.)

Sol. in conc. HCl + Aq. (Mylius and Förster.)

***Di*carbonyl platinous chloride**, $2CO, PtCl_2$.

Decomp. by H_2O and alcohol. Sol. in CCl_4. (Schützenberger.)

Decomp. by conc. HCl + Aq into CO and $CO, PtCl_2$. (Mylius and Förster.)

***Sesqui*carbonyl platinous chloride**, $3CO, 2PtCl_2$.

Decomp. by H_2O or alcohol. Much more sol. in CCl_4 than $2CO, PtCl_2$.

Carbonyl platinous iodide, CO, PtI_2.

Not hygroscopic. Insol. in, but slowly decomp. by, H_2O. Easily sol. in benzene or ether, also in alcohol, which decomp. on warming ; sol. in HI + Aq. (Mylius and Förster.)

Carbonyl platinous sulphide, CO, PtS.

Easily decomp. Insol. in ordinary solvents. (Mylius and Förster.)

Carbonyl sulphide, COS.

H_2O absorbs 1 vol. COS.

Cerium, Ce.

Decomp. pure H_2O very slowly at ordinary temp. Not attacked by cold conc. H_2SO_4 or red fuming HNO_3. Sol. in dil. H_2SO_4 + Aq, HNO_3 + Aq, and conc. or dil. HCl + Aq. (Hillebrand and Norton, Pogg. **155**. 633.)

Cerous bromide, $CeBr_3$.

Anhydrous. As the chloride. (Robinson, Proc. Roy. Soc. **37**. 150.)

+ xH_2O. Very deliquescent. (Jolin.)

Cerium gold bromide, $CeBr_3, AuBr_3 + 8H_2O$.

See **Bromaurate, cerium.**

Cerium carbide, CeC_3.

Not attacked by hot conc. acids. (Delafontaine, J. B. **1865.** 176.)

Cerous chloride, $CeCl_3$.

Anhydrous. Deliquescent. Sol. in H_2O with hissing and evolution of heat; sol. in alcohol.

$+7H_2O$. (Jolin, Bull. Soc. (2) **21.** 533.)

$+7\frac{1}{2}H_2O$. Deliquescent. (Berzelius.)

Decomp. by boiling with H_2O. Sol. in 1 pt. H_2O at ord. temp. and 3-4 pts. alcohol. (Dumas.)

Ceric chloride.

Known only in solution, which decomposes by slight heat. (Berzelius.)

Cerous mercuric chloride.

Not deliquescent. (v. Bonsdorff.)

$CeCl_3, 4HgCl_2+10H_2O$. Permanent; easily sol. in H_2O. (Jolin, Bull. Soc. (2) **21.** 533.)

Cerium stannic chloride.

See **Chlorostannate, cerium.**

Cerous chloride zinc iodide.

Sol. in H_2O and alcohol. (Holzmann, J. pr. **84.** 76.)

Cerous fluoride, CeF_3.

Insol. ppt.

$+\frac{1}{2}H_2O$.

Ceric fluoride, CeF_4.

Insoluble precipitate. (Berzelius.)

$+H_2O$. Insol. in H_2O. (Brauner, B. **14.** 1944.)

Ceric potassium fluoride, $2CeF_4, 3KF+2H_2O$.

Insol. in H_2O. (Brauner, B. **14.** 1944; **15.** 109.)

Ceroceric fluoride, $2CeF_3, CeF_4$.

Min. *Fluocerite.*

Cerium hydride, CeH_2.

Decomp. by acids. (Winkler, B. **24.** 873.)

Cerous hydroxide, Ce_2O_3, xH_2O.

Easily sol. in acids. Insol. in excess of alkali hydroxides+Aq. Sol. in $(NH_4)_2CO_3$+Aq.

Ceric hydroxide, $2CeO_2, 3H_2O$.

Sol. in HNO_3 or H_2SO_4; also in HCl+Aq, forming cerous chloride and free chlorine. Insol. in hydrofluoric, acetic, or formic acids+Aq. Somewhat sol. in dil. HNO_3, or HCl+Aq. (Ordway, Am. J. Sci. (2) **26.** 205.) Insol. in NH_4OH, KOH, and NaOH+Aq. Sl. sol. in alkali carbonates+Aq. (Dumas.)

Sl. sol. in $(NH_4)_2CO_3$+Aq. (Ordway.)

Cerous iodide, CeI_3+9H_2O.

Very deliquescent and sol. in H_2O. (Lange, J. pr. **82.** 134.)

Sol. in alcohol.

Cerous oxide, Ce_2O_3.

When ignited, insol. in HCl+Aq; when long digested with H_2SO_4, is sol. in HCl+Aq with addition of alcohol.

Ceric oxide, CeO_2.

When ignited, is only dissolved in traces, even on heating, by HCl or HNO_3+Aq. Sol. in conc. H_2SO_4 when warmed. Sol. in the cold in a solution of KI in HCl+Aq (Bunsen), in a mixture of HCl and $FeCl_2$+Aq, or any reducing substance.

Cerium *per***oxide,** Ce_4O_9.

Insol. in boiling conc. acids. Sol. in H_2SO_4 by long digestion. (Popp, A. **131.** 361.)

Probably does not exist. (Rammelsberg, Pogg. **108.** 40.)

Ce_2O_5. (Hermann, J. pr. **30.** 184.)

Probably does not exist. (Rammelsberg.)

CeO_3+xH_2O. Sol. in HCl+Aq. (Popp, A. **131.** 361.)

(Lecoq de Boisbaudran, C. R. **100.** 605.)

$CeO_2+H_2O_2$, according to Cleve (Bull. Soc. (2) **43.** 57).

Cerium oxychloride, CeOCl.

Slightly attacked by hot conc. HCl+Aq. Slowly sol. in conc. HNO_3+Aq. (Wöhler.)

Easily sol. in dil. acids. (Didier, C. R. **101.** 882.)

Cerium oxychloride tungsten *tri***oxide,** $CeOCl, WO_3$.

(Didier, C. R. **102.** 823.)

Cerium selenide.

Insol. in H_2O; difficultly sol. in acids. (Berzelius.)

Cerium silicide, Ce_2Si_3.

Insol. in acids. (Ullik, W. A. B. **52, 2.** 115.)

Cerium *sesqui***sulphide,** Ce_2S_3.

Insol. in, and not decomp. by H_2O, but easily decomp. by the weakest acids. (Mosander; Didier, C. R. **100.** 1461.)

Chlor*tetr***amine comps.**

See **Chlorotetramine comps.**

Chlorarsenious acid.

See **Arsenyl chloride.**

Chlorauric acid, $HAuCl_4+4H_2O$.

Sol. in H_2O, alcohol, and ether.

Chloraurates.

All chloraurates are easily sol. in H_2O and in alcohol. (v. Bonsdorff, **1829.**)

Ammonium chloraurate, $NH_4AuCl_4+H_2O$.

Very easily sol. in H_2O.

$+2H_2O$. Very easily sol. in H_2O.

Barium chloraurate, $Ba(AuCl_4)_2+xH_2O$.

Deliquescent in moist air. Sol. in H_2O and alcohol. (v. Bonsdorff, Pogg. **17.** 261.)

Cadmium chloraurate.

Not deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cæsium chloraurate, $CsAuCl_4$.

100 pts. aqueous sat. solution contain at:

10°	20°	30°	40°	50°	
0·5	0·8	1·7	3·2	5·4	pts. anhydrous salt,
60°	70°	80°	90°	100°	
8·2	12·0	16·3	21·7	27·5	pts. anhydrous salt.

(Rosenbladt, B. **19.** 2538.)

$+\frac{1}{2}H_2O$. (Wells and Wheeler, Sill. Am. J. **144.** 157.)

Calcium chloraurate, $Ca(AuCl_4)_2+6H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cerium chloraurate, $CeCl_3$, $AuCl_3+10H_2O$.

Extremely deliquescent. Easily sol. in H_2O and absolute alcohol. (Holzmann, C. C. **1863.** 206.)

$+13H_2O$. (Jolin, Bull. Soc. (2) **21.** 534.)

Cobalt chloraurate, $Co(AuCl_4)_2+8H_2O$.

Sol. in H_2O and alcohol. (Topsoë.)

Didymium chloraurate, $DiCl_3$, $AuCl_3+10H_2O$.

Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 361.)

$2DiCl_3$, $3AuCl_3+20H_2O$. (Cleve.)

Lanthanum chloraurate, $LaCl_3$, $AuCl_3+5H_2O$.

Deliquescent in moist air. Sol. in H_2O. (Cleve, B. **8.** 128.)

Lithium chloraurate, $LiAuCl_4$.

100 pts. aqueous solution contain at:

10°	20°	30°	40°	
53·1	57·7	62·5	67·3	pts. anhydrous salt,
50°	60°	70°	80°	
72·0	76·4	81·0	85·7	pts. anhydrous salt.

(Rosenbladt.)

Magnesium chloraurate, $Mg(AuCl_4)_2+8H_2O$.

Somewhat deliquescent. Sol. in H_2O and alcohol. (Topsoë.)

$+12H_2O$.

Manganese chloraurate, $Mn(AuCl_4)_2+8H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Topsoë.)

$+12H_2O$.

Nickel chloraurate, $Ni(AuCl_4)_2+8H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Topsoë).

Potassium chloraurate, $KAuCl_4$.

Anhydrous. Very stable. (Lainer, W. A. B. **99, 2b.** 247.)

$+2H_2O$. Efflorescent.

$+\frac{1}{2}H_2O$.

100 pts. solution in H_2O contain at:

10°	20°	30°	
27·7	38·2	48·7	pts. anhydrous salt,
40°	50°	60°	
59·2	70·0	80·2	pts. anhydrous salt.

(Rosenbladt, B. **19.** 2538.)

Sol. in alcohol.

Rubidium chloraurate, $RbAuCl_4$.

100 pts. sat. $RbAuCl_4+Aq$ contain at:

10°	20°	30°	40°	50°	
4·6	9·0	13·4	17·7	22·2	pts. anhydrous salt,
60°	70°	80°	90°	100°	
26·6	31·0	35·3	39·7	44·2	pts. anhydrous salt.

(Rosenbladt.)

Easily sol. in 95 % alcohol.

Samarium chloraurate, $SmCl_3$, $AuCl_3+10H_2O$.

Deliquescent. Easily sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 165.)

Sodium chloraurate, $NaAuCl_4+2H_2O$.

Easily sol. in H_2O and absolute alcohol.

100 pts. aqueous solution contain at:

10°	20°	30°	
58·2	60·2	64·0	pts. anhydrous salt,
40°	50°	60°	
69·4	77·5	90·0	pts. anhydrous salt.

(Rosenbladt.)

Easily sol. in NaCl + Aq.

Strontium chloraurate.

Sol. in H_2O and alcohol. (v. Bonsdorff.)

Thallium chloraurate.

(Carstanjen.)

Yttrium chloraurate, $YtCl_3$, $2AuCl_3+16H_2O$.

Very sol. in H_2O. (Cleve.)

Zinc chloraurate, $Zn(AuCl_4)_2+8H_2O$.

Sol. in H_2O. (Topsoë.)

$+12H_2O$. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Chlorauricyanhydric acid.

Barium chlorauricyanide, $Ba[Au(CN)_2Cl_2]_2+8H_2O$.

Very sol. in H_2O or alcohol. (Lindbom, Lund Univ. Arsk. **12.** No. 6.)

Potassium chlorauricyanide, $KAu(CN)_2Cl_2+H_2O$.

Very sol. in H_2O or alcohol.

Strontium chlorauricyanide, $Sr[Au(CN)_2Cl_2]_2+8H_2O$.

Sol. in H_2O.

Zinc chlorauricyanide, $Zn[Au(CN)_2Cl_2]_2+7H_2O$.

Very sol. in H_2O.

Chlorhydric acid, HCl.

Liquid. Miscible with liquid CO_2, and H_2S.

Gas. Absorbed by H_2O with production of much heat.

H_2O absorbs 400-500 vols. at ord. temp. and pressure = a little less than 1 pt. by weight. (Dalton.)

1 vol. H_2O absorbs 480 vols. at 0°; sp. gr. of sat. solution is 1·2109. (Davy.)

1 vol. H_2O absorbs 417·822 vols. at 20°, the vol. increasing to 1·4138 vols.; 1 vol. of HCl + Aq then contains 311 vols. HCl, has sp. gr. 1·1958, and contains 40·39 % HCl by weight. (Thomson, **1831.**)

1 vol. H_2O absorbs 464 vols. and sat. solution has 1·21 sp. gr. and contains 42·4 % HCl by weight. (Wittstein.)

H_2O sat. at 0° contains 480 times its vol. of HCl, and sp. gr. = 1·2109; sat. at ord. temp., contains 38·3 % of its weight in HCl, and sp. gr. = 1·192. (Berzelius.)

1 vol. H_2O absorbs V vols. HCl at t° and 760 mm. pressure, and the liquid formed has the given sp. gr., and contains the given per cent HCl.

t°	V	Sp. gr.	% HCl
0	525·2	1·2257	45·148
4	494·7	1·2265	44·361
8	480·3	1·2185	43·828
12	471·3	1·2148	43·277
14	462·4	1·2074	42·829
18	451·2	1·2064	42·344
18·25	450·7	1·2056	42·283
23	435·0	1·2014	41·536

(Deicke, Pogg. **119.** 156.)

At 760 mm. pressure 1 g. H_2O absorbs g. HCl at t°.

t°	g. HCl	t°	g. HCl	t°	g. HCl
0	0·825	22	0·710	44	0·618
2	0·814	24	0·700	46	0·611
4	0·804	26	0·691	48	0·603
6	0·793	28	0·682	50	0·596
8	0·783	30	0·673	52	0·589
10	0·772	32	0·665	54	0·582
12	0·762	34	0·657	56	0·575
14	0·752	36	0·649	58	0·568
16	0·742	38	0·641	60	0·561
18	0·731	40	0·633	...	...
20	0·721	42	0·626	...	...

(Roscoe and Dittmar.)

Conc. HCl+Aq loses HCl, and dil. HCl+Aq loses H_2O on warming, until an acid of constant composition is formed, containing 20·18 % HCl, with a sp. gr. of 1·101 at 15°, which can be distilled unchanged at 110°. (Bineau, A. ch. (3) **7.** 257.)

The above is true if barometer is at 760 mm., but the composition changes with the pressure as follows—

Mm. Hg	% HCl	Mm. Hg.	% HCl	Mm. Hg	% HCl
50	23·2	800	20·2	1700	18·8
100	22·9	900	19·9	1800	18·7
200	22·3	1000	19·7	1900	18·6
300	21·8	1100	19·5	2000	18·5
400	21·4	1200	19·4	2100	18·4
500	21·1	1300	19·3	2200	18·3
600	20·7	1400	19·1	2300	18·2
700	20·4	1500	19·0	2400	18·1
760	20·24	1600	18·9	2500	18·0

(Roscoe and Dittmar.)

Conc. HCl+Aq gradually gives off HCl on the air until it has a sp. gr. 1·128 at 15°, and contains 25·2 % HCl. (Bineau, *l.c.*)

According to Roscoe and Dittmar, this depends on the temperature. If a current of air is passed through HCl+Aq, acid or water is given off according as the acid is strong or weak, until an acid of constant composition for a given temperature is formed, as follows—

Temp.	% HCl	Temp.	% HCl	Temp.	% HCl
0°	25·0	35°	23·9	70°	22·6
5	24·9	40	23·8	75	22·3
10	24·7	45	23·6	80	22·0
15	24·6	50	23·4	85	21·7
20	24·4	55	23·2	90	21·4
25	24·3	60	23·0	95	21·1
30	24·1	65	22·8	100	20·7

From the above it is seen that the acid which distils unchanged at a given pressure, that is, boils at a certain constant temperature, is identical with the acid which undergoes no change in composition by a current of dry air at the same temperature, and under the ordinary pressure, thus—

Mm. Hg	B.-pt.	% HCl	Temp. of air current	% HCl
100	61-62°	22·8	62°	22·9
200	76-77	22·1	77	22·2
300	84-85	21·7	85	21·7
380	91	21·3	91	21·4
490	97	20·9	98	21·1
620	103	20·6	...	...

(Roscoe and Dittmar.)

Solubility of HCl in H_2O at 0° under different degrees of pressure. P=partial pressure in mm. Hg, *i.e.* total pressure minus the tension of aqueous vapour at the given temp.; G=grammes of HCl dissolved in 1 g. H_2O at the pressure P and 0° temp.

P	G	P	G
60	0·613	350	0·751
70	0·628	400	0·763
80	0·640	450	0·772
90	0·649	500	0·782
100	0·657	550	0·791
110	0·664	600	0·800
120	0·670	650	0·808
130	0·676	700	0·817
140	0·681	750	0·824
150	0·686	800	0·831
175	0·697	900	0·844
200	0·707	1000	0·856
225	0·716	1100	0·869
250	0·724	1200	0·882
275	0·732	1300	0·895
300	0·738	...	...

(Roscoe and Dittmar, A. **112.** 334.)

1 vol. H_2O dissolves 560 vols. HCl at −12°
" " 500 " " 0°
" " 440 " " +20°

(Berthelot, C.R. **76.** 779.)

1 vol. H_2O absorbs 480 vols. HCl at 15° to form a solution containing 42·85 % HCl with a sp. gr. of 1·215. (Hager.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1·203	40·66	1·1285	27·21	1·0960	20·44
1·179	37·00	1·1197	25·52	1·0902	19·47
1·162	33·95	1·1127	24·03	1·0860	18·59
1·149	31·35	1·1060	22·70	1·0820	17·79
1·139	29·13	1·1008	21·51	1·0780	17·05

(Thomson, in his System, **2.** 189.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl
1·21	42·43	1·10	20·20
1·20	40·80	1·09	18·18
1·19	38·38	1·08	16·16
1·18	36·36	1·07	14·14
1·17	34·34	1·06	12·12
1·16	32·32	1·05	10·10
1·15	30·30	1·04	8·08
1·14	28·28	1·03	6·06
1·13	26·26	1·02	4·04
1·12	24·24	1·01	2·02
1·11	20·30	..	..

(Edm. Davy.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	B.-pt.	Sp. gr.	% HCl	B.-pt.
1·199	34·01	49°	1·094	16·08	111°
1·181	31·09	65	1·075	13·16	109
1·166	28·29	76	1·064	11·16	107
1·154	26·57	87	1·047	8·62	105
1·144	24·84	100	1·035	6·92	104
1·136	23·25	103	1·018	3·52	102
1·127	21·06	105	1·009	1·86	101
1·121	20·74	109	..	..	..

(Kirwan and Dalton.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.
2·22	1·0103	29·72	1·1504
3·80	1·0189	31·50	1·1588
6·26	1·0310	34·24	1·1730
11·02	1·0557	36·63	1·1844
15·20	1·0751	38·67	1·1938
18·67	1·0942	40·51	1·2021
20·91	1·1048	41·72	1·2074
23·72	1·1196	43·09	1·2124
25·96	1·1308	..	..

(Kolb, C. R. **74.** 337.)

Sp. gr. of HCl+Aq at 15°.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1·2000	40·777	1·1859	37·516	1·1701	34·252
1·1982	40·369	1·1846	37·108	1·1681	33·845
1·1964	39·961	1·1822	36·700	1·1661	33·437
1·1946	39·554	1·1802	36·292	1·1641	33·029
1·1928	39·146	1·1782	35·884	1·1620	32·621
1·1910	38·738	1·1762	35·476	1·1599	32·213
1·1893	38·330	1·1741	35·068	1·1578	31·805
1·1875	37·923	1·1721	34·660	1·1557	31·398

Sp. gr. of HCl+Aq at 15°—*Continued.*

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1·1536	30·990	1·1000	20·288	1·0497	10·194
1·1515	30·582	1·0980	19·980	1·0477	9·768
1·1494	30·174	1·0960	19·572	1·0457	9·379
1·1473	29·767	1·0939	19·165	1·0437	8·971
1·1452	29·359	1·0919	18·757	1·0417	8·563
1·1431	28·951	1·0899	18·349	1·0397	8·155
1·1410	28·544	1·0879	17·941	1·0377	7·747
1·1389	28·136	1·0859	17·534	1·0357	7·340
1·1369	27·728	1·0838	17·126	1·0337	6·932
1·1349	27·321	1·0818	16·718	1·0318	6·524
1·1328	26·913	1·0798	16·310	1·0298	6·116
1·1308	26·505	1·0778	15·902	1·0279	5·709
1·1287	26·098	1·0758	15·494	1·0259	5·301
1·1267	25·690	1·0738	15·087	1·0239	4·893
1·1247	25·282	1·0718	14·679	1·0220	4·486
1·1226	24·874	1·0697	14·271	1·0200	4·078
1·1206	24·466	1·0677	13·363	1·0180	3·670
1·1185	24·058	1·0657	13·456	1·0160	3·262
1·1164	23·650	1·0637	13·409	1·0140	2·854
1·1143	23·242	1·0617	12·641	1·0120	2·447
1·1123	22·834	1·0597	12·233	1·0100	2·039
1·1102	22·426	1·0577	11·825	1·0080	1·631
1·1082	22·019	1·0557	11·418	1·0060	1·224
1·1061	21·611	1·0537	11·010	1·0040	0·816
1·1041	21·203	1·0517	10·602	1·0020	0·408
1·1020	20·796	..	..	..	..

(Ure, Handwörterbuch.)

Sp. gr. of HCl+Aq. U=sp. gr. at 15·55° according to Ure; K=sp. gr. at 15° according to Kremers.

% HCl	U	K	% HCl	U	K
1	1·005	1·005	22	1·109	1·111
2	1·010	1·010	23	1·114	1·116
3	1·015	1·015	24	1·119	1·121
4	1·020	1·020	25	1·124	1·126
5	1·025	1·025	26	1·128	1·131
6	1·030	1·030	27	1·133	1·136
7	1·034	1·034	28	1·138	1·141
8	1·039	1·039	29	1·143	1·146
9	1·044	1·044	30	1·147	1·151
10	1·048	1·048	31	1·153	1·157
11	1·053	1·053	32	1·157	1·163
12	1·059	1·059	33	1·163	1·169
13	1·064	1·065	34	1·169	1·179
14	1·069	1·070	35	1·174	...
15	1·074	1·075	36	1·179	...
16	1·079	1·080	37	1·183	...
17	1·084	1·085	38	1·188	...
18	1·089	1·090	39	1·193	...
19	1·094	1·095	40	1·197	...
20	1·098	1·100	41	1·203	...
21	1·104	1·105	...	...	...

(Calculated by Gerlach, Z. anal. **8.** 292.)

Relation of sp. gr. of HCl+Aq at t° to sp. gr. at 19·5°=1·0.

t°	8·9 % HCl sp. gr.=1·0401	16·6 % HCl sp. gr.=1·0704	25·5 % HCl sp. gr.=1·101	35·8 % HCl sp. gr.=1·133	46·6 % HCl sp. gr.=1·1608
0	0·99557	0·99379	0·99221	0·99079	0·98982
19·5	1·00000	1·00000	1·00000	1·00000	1·00000
40	1·00707	1·00781	1·00877	1·00990	1·01063
60	1·01588	1·01665	1·01794	1·01969	1·02180
80	1·02639	1·02676	1·02791	1·02986	...
100	1·03855	1·03801	1·03867	1·04059	...

(Kremers, Pogg. **108.** 115.)

Sp. gr. of HCl+Aq at 15° (H_2O at 0°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
0	0·9992	15	1·07539	30	1·15079
1	1·00503	16	1·08042	31	1·15581
2	1·01005	17	1·08545	32	1·16084
3	1·01508	18	1·09047	33	1·16587
4	1·02010	19	1·09550	34	1·17089
5	1·02513	20	1·10052	35	1·17592
6	1·03016	21	1·10555	36	1·18095
7	1·03518	22	1·11058	37	1·18597
8	1·04021	23	1·11560	38	1·191
9	1·04524	24	1·12063	39	1·196
10	1·05026	25	1·12566	40	1·200
11	1·05529	26	1·13068	41	1·204
12	1·06031	27	1·13571	42	1·208
13	1·06534	28	1·14074	43	1·212
14	1·07037	29	1·14516	...	...

(Kolb, recalculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
5	1·0244	20	1·0982	35	1·1739
10	1·0488	25	1·1234	40	1·1969
15	1·0733	30	1·1488	41	1·2013

(Hager, Adjumenta varia, Leipzig, **1876.**)

Sp. gr. of HCl+Aq at 15° (H_2O at 15°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.
44·345	1·21479	34·464	1·17138
43·136	1·21076	25·260	1·12479
41·901	1·20430	19·688	1·09675
41·212	1·20204	14·788	1·07255
39·831	1·19703	6·382	1·03150
37·596	1·18687	...	...

(Pickering, B. **26.** 277.)

Most accurate table.

Sp. gr. of HCl+Aq at 15° (H_2O at 4°=1).

Sp. gr.	% HCl	Kg. HCl in 1 l.	Sp. gr.	% HCl	Kg. HCl in 1 l.
1·000	0·16	0·016	1·070	14·17	0·152
1·005	1·15	0·012	1·075	15·16	0·163
1·010	2·14	0·022	1·080	16·15	0·174
1·015	3·12	0·032	1·085	17·13	0·186
1·020	4·13	0·042	1·090	18·11	0·197
1·025	5·15	0·053	1·095	19·06	0·209
1·030	6·15	0·064	1·100	20·01	0·220
1·035	7·15	0·074	1·105	20·97	0·232
1·040	8·16	0·085	1·110	21·92	0·243
1·045	9·16	0·096	1·115	22·86	0·255
1·050	10·17	0·107	1·120	23·82	0·267
1·055	11·18	0·118	1·125	24·78	0·278
1·060	12·19	0·129	1·130	25·75	0·291
1·065	13·19	0·141	1·135	26·70	0·303

Sp. gr. of HCl, etc.—*Continued.*

Sp. gr.	% HCl	Kg. HCl in 1 l.	Sp. gr.	% HCl	Kg. HCl in 1 l.
1·140	27·66	0·315	1·175	34·42	0·404
1·145	28·61	0·322	1·180	35·39	0·418
1·150	29·57	0·340	1·185	36·31	0·430
1·155	30·55	0·353	1·190	37·23	0·443
1·160	31·52	0·366	1·195	38·16	0·456
1·165	32·49	0·379	1·200	39·11	0·469
1·170	33·46	0·392	...	...	...

(Lunge and Marchlewski, Z. angew. Ch. **1891.** 133.)

HCl is not absorbed by conc. H_2SO_4+Aq, but in large amounts by anhydrous H_2SO_4. (Aimé.)

100 pts. alcohol of 36° B absorb 68 pts. HCl at 12·5°. (Boullay.)

Alcohol of 0·836 sp. gr. dissolves 327 vols. HCl at 17·5° and 758 mm. pressure, and the solution has sp. gr.=1·005. (Pierre, A. ch. (3) **31.** 135.)

Solubility of HCl in methyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
−10·3	54·6	18	46·9
0	51·3	31·7	43

(de Bruyn, R. t. c. **11.** 112.)

Solubility of HCl in ethyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
0	45·4	19·2	41
6·5	44·2	23·5	40·2
11·5	42·7	32·0	38·1

(de Bruyn, *l.c.*)

Sol. in glacial $HC_2H_3O_2$, ether, hexane, benzene, xylene, etc.

Oil of turpentine absorbs 50 % HCl. (Thénard.)

Oil of turpentine absorbs 163 vols. HCl at 22° and 724 mm.; isoterebenthene absorbs 34 % at 24° and 724 mm.; metaterebenthene absorbs 17·7 % at 24° and 724 mm. (Berthelot.)

Oil of lavender absorbs 68·7 vols. at 24° (Thénard.)

Oil of lavender absorbs 210 vols. without being saturated; oil of rosemary absorbs 218 vols. at 22°; sol. in 0·4 vol. petroleum. (Saussure.)

Absorbed by caprylic alcohol. (Bouis.)

Fuming HCl+Aq is sol. in glycerine and miscible with conc. $HC_2H_3O_2$.

+$2H_2O$. (Pierre and Puchot, C. R. **82.** 45.)

Chlorhydric cyanhydric acid, 3HCl, 2HCN.

Decomp. by H_2O or alcohol; sol. in $HC_2H_3O_2$. Insol. in ether, chloroform, or acetic ether. (Claisen, B. **16.** 309.)

HCl, HCN. Sol. in H_2O, absolute alcohol, $HC_2H_3O_2$, and $CHCl_3$, with decomp.; decomp. is especially rapid in H_2O.

Insol. in H_2O. (Gautier, A. ch. (4) **17.** 130.)

Chloric acid, $HClO_3$.

Known only in aqueous solution, which can be concentrated in vacuo to a sp. gr. of 1·282 at 14·2°, and then contains 40·10 % $HClO_3$, corresponding to $HClO_3+7H_2O$; if left longer in vacuo over H_2SO_4 an acid corresponding to $HClO_3+4\frac{1}{2}H_2O$ is obtained. Aqueous solution of $HClO_3$ decomp. at 40°. (Kämmerer, Pogg. **138.** 390.)

Chlorates.

All chlorates except mercurous chlorate are sol. in H_2O; most of them are deliquescent; many are sol. in alcohol.

Aluminum chlorate.

Deliquescent. Easily sol. in H_2O. Sol. in alcohol. (Chevenix, **1802.**)

Ammonium chlorate, NH_4ClO_3.

Easily sol. in H_2O; less sol. in alcohol.

Much less sol. in H_2O at 0° than $NaClO_3$. (Storer.)

Very sl. sol. in absolute alcohol. (Wächter, J. pr. **30.** 321.)

Barium chlorate, $Ba(ClO_3)_2+H_2O$.

Sol. in 4 pts. cold, and less hot H_2O. (Chevenix.)

100 pts. H_2O dissolve at:

0°	20°	40°	60°	80°	100°	
22·8	37·0	52·1	77·5	98·0	126·4	pts. $Ba(ClO_3)_2$.

Sat. solution boils at 111°. (Kremers, Pogg. **99.** 43.)

Only slight traces dissolve in absolute alcohol. (Wächter, J. pr. **30.** 334.)

Bismuth chlorate.

Known only in solution, which decomp. on evaporation.

Cæsium chlorate, $CsClO_3$.

(Retgers, Z. phys. Ch. **5.** 449.)

Cadmium chlorate, $Cd(ClO_3)_2+2H_2O$.

Very deliquescent; sol. in H_2O and alcohol. Melts in crystal H_2O at 80°. (Wächter, J. pr. **30.** 321.)

Calcium chlorate, $Ca(ClO_3)_2+2H_2O$.

Deliquescent; very sol. in H_2O and alcohol. (Wächter, J. pr. **30.** 323.)

Melts in its water of crystallisation at over 100°.

Chromic chlorate.

Easily sol. in H_2O. (Prudhomme, C. C. **1890, 1.** 668.)

Cobaltous chlorate, $Co(ClO_3)_2+6H_2O$.

Very deliquescent. Sol. in H_2O and alcohol. Melts in crystal H_2O at 50°. (Wächter, J. pr. **30.** 321.)

Cupric chlorate, basic.

Insol. in H_2O. Easily sol. in dil. acids. (Wächter.)

Cupric chlorate, $Cu(ClO_3)_2+6H_2O$.

Very deliquescent. Easily sol. in H_2O and alcohol. Melts in its crystal H_2O at 65°. (Wächter, J. pr. **30.** 321.)

Erbium chlorate, $Er(ClO_3)_3+8H_2O$.

Deliquescent. Sol. in H_2O and alcohol.

Glucinum chlorate.

Known only in aqueous solution, which decomposes on evaporation.

Ferrous chlorate.

Known only in solution.

Ferric chlorate, $Fe(ClO_3)_3$.

Sol. in H_2O.

Basic salt. Insol. in H_2O.

Lanthanum chlorate, $La(ClO_3)_3$.

Deliquescent. (Cleve.)

Lead chlorate, $Pb(ClO_3)_2+H_2O$.

Deliquescent; easily sol. in H_2O and alcohol. (Wächter, J. pr. **30.** 321.)

Lithium chlorate, $LiClO_3+\frac{1}{2}H_2O$.

Very deliquescent and sol. in H_2O. Very easily sol. in alcohol. Melts at 50° in its crystal water. (Wächter, J. pr. **30.** 321.)

Contains $3H_2O$, and is not deliquescent. (Lagorio, Zeit. f. Kryst. **15.** 80.)

Salt is anhydrous. (Retgers, Z. phys. Ch. **5.** 449.)

Magnesium chlorate, $Mg(ClO_3)_2+6H_2O$.

Very deliquescent and sol. in H_2O. Very easily sol. in alcohol. Melts at 40° in its crystal water. (Wächter, J. pr. **30.** 325.)

Manganous chlorate, $Mn(ClO_3)_2$.

Known only in solution which decomposes on evaporation. (Wächter.)

Mercurous chlorate, $Hg_2(ClO_3)_2$.

a. Easily sol. in alcohol and H_2O. (Wächter, J. pr. **30.** 321.)

β. Insol. in H_2O; easily sol. in $HC_2H_3O_2+$Aq. (Wächter.) Decomp. by boiling H_2O.

Mercuric chlorate, $2HgO, Cl_2O_5+H_2O$.

Deliquescent. Decomp. by H_2O into oxide and an acid salt. (Wächter.)

Sol. in 4 pts. cold H_2O. (Chevenix, **1802.**)

Nickel chlorate, $Ni(ClO_3)_2+6H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol. Melts in crystal H_2O at 80°. (Wächter, J. pr. **30.** 321.)

Potassium chlorate, $KClO_3$.

Sol. in H_2O with absorption of heat.

Sol. in about 16 pts. cold, and in much less hot H_2O. (Chevenix, **1802.**)

Sol. in 30·03 pts. H_2O at 0°; 17·85 pts. at 13·3°; and in 1·66 pts. at 104·78°. (M. R. and P.)

Sol. in 16 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O at 15·5° dissolve 6·2 pts.; at 100°, 40 pts. (Ure's Dict.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°—

t°	28	35	40	47	65
Pts. $KClO_3$.	9·5	12·3	14·4	18·3	29·1

(Gerardin.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
0	3·33	35·0	12·05
13·32	5·60	49·08	18·96
15·37	6·03	74·89	35·40
24·43	8·44	104·78	60·24

(Gay-Lussac, A. ch. **11.** 314.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
0	3·3	130	88·5
100	56·5	180	190

(Tilden and Shenstone, Roy. Soc. Proc. **35.** 345.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
120	73·7	160	148
136	98·9	190	183

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Coefficient of solubility is 3·2+0·109t+0·0043t² between 0° and 35°. (Blarez, C. R. **112.** 1213.)

Sp. gr. of $KClO_3$+Aq, according to Kremer's experiments (Pogg. **96.** 62), and Gerlach's calculations. (Z. anal. **8.** 290.)

% $KClO_3$	Sp. gr.	% $KClO_3$	Sp. gr.
1	1·007	6	1·039
2	1·014	7	1·045
3	1·020	8	1·052
4	1·026	9	1·059
5	1·033	10	1·066

Sp. gr. of $KClO_3$+Aq at 20° containing 1 mol. $KClO_3$ to 100 mols. H_2O=1·04122. (Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of $KClO_3$+Aq at 15° containing 5 % $KClO_3$=1·0316. (Kohlrausch, W. Ann. **1879.** 1.)

B.-pt. of $KClO_3$+Aq containing pts. $KClO_3$ to 100 pts H_2O.

Pts. $KClO_3$	B.-pt.	Pts. $KClO_3$	B.-pt.
6·5	100·5°	44·6	103·0°
13·2	101·0	53·4	103·5
20·2	101·5	62·2	104·0
27·8	102·0	69·2	104·4
35·8	102·5	...	...

(Gerlach, Z. anal. **26.** 450.)

Saturated solution boils at 105°. (Kremers.)

Saturated solution boils at 104·2°, and contains 61·5 pts. $KClO_3$ to 100 pts. H_2O. (Legrand.)

Saturated solution boils at 103·3°, and contains 66·6 pts. $KClO_3$ to 100 pts. H_2O. (Griffiths.)

Saturated solution boils at 104·4°. (Gerlach, Z. anal. **26.** 427.)

Sol. in pure HNO_3 without decomp., but decomp. at once by HNO_3 containing NO_2. (Millon, A. ch. (3) **6.** 92.)

Sol. in sat. NH_4Cl+Aq without causing pptn.

1 mol. (=129 pts.) $KClO_3$ dissolves in 2493 vols. H_2O; in 2208 vols. H_2O when 1 mol. (=59 pts.) NaCl is added; in 2060 vols. H_2O with 2 mols. (=118 pts.) NaCl; and in 1910 vols. H_2O with 4 mols. (=236 pts.) NaCl. (Gladstone, Chem. Soc. **15.** 302.)

$KClO_3$ is sol. in about—

29·50 pts. H_2O.

35·50 pts. NH_4OH+Aq conc.

39·00 pts. dil. NH_4OH+Aq (1 vol. conc.: 3 vols. H_2O).

30·50 pts. HNO_3+Aq (1 vol. conc. HNO_3: 5 vols. H_2O).

33·00 pts. HCl+Aq (1 vol. conc. HCl: 4 vols. H_2O).

48·00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial $HC_2H_3O_2$: 1 vol. H_2O).

31·50 pts. NH_4Cl+Aq (1 pt. NH_4Cl: 10 pts. H_2O).

18·00 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3: 10 pts. H_2O).

34·00 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH+Aq+dil. $HC_2H_3O_2$+Aq).

32·50 pts. $NaC_2H_3O_2$ + Aq (commercial $HC_2H_3O_2$+Na_2CO_3, diluted with 4 vols. H_2O).

31·50 pts. $Cu(C_2H_3O_2)_2$+Aq. (*See* Stolba, Z. anal. **2.** 390.)

33·50 pts. cane-sugar (1 pt. cane-sugar: 10 pts. H_2O).

36·50 pts. grape-sugar (1 pt. grape-sugar: 10 pts. H_2O). (Pearson, Zeit. Chem. **1869.** 662.)

Addition of K salts to sat. $KClO_3$+Aq ppts. $KClO_3$ in such a way, that the sum of the $KClO_3$ remaining in solution and the K in the salt added, is a constant, which constant is equal to the solubility of $KClO_3$, so that the following formula represents the coefficiency of solubility of $KClO_3$ after addition of a K salt, 3·2+0·109t+0·0043t²−K of salt added. (Blarez, C. R. **112.** 1213.)

Sol. in 120 pts. alcohol of 83 % at 16°. (Wittstein.)

Sol. in 120 pts. alcohol of 77·1 %. (Pohl, W. A. B. **6.** 595.)

Insol. in absolute alcohol. (Gerardin.)

Solubility of $KClO_3$ in dil. alcohol. D=sp. gr. of alcohol; S=solubility in 100 pts. alcohol at t°.

D=0·9904		D=0·9848		D=0·9793	
t°	S	t°	S	t°	S
13	4·9	14	4·7	14	3·2
21	6·3	26	7·1	26	5·4
25	7·5	39	9·3	38	7·9
30	9·1	47	12·8	46	10·8
35	10·2	55	16·1	51	12·2
44	13·6	65	22·3	63	17·5
50	16·2	66	22·5	65	19·0

Solubility of $KClO_3$, etc.—*Continued.*

D=0·9726		D=0·9573		D=0·9390	
t°	S	t°	S	t°	S
13	2·2	13	1·9	14·5	1·1
20	3·3	20	2·7	28	2·2
33	5·8	29	3·6	40	3·4
43	7·2	36	4·3	50	4·3
56	11·4	55	7·9	62	6·6
59	12·9	60	9·7	67	7·6
...	...	63	10·5	...	...

D=0·9111		D=0·8967		D=0·8429	
t°	S	t°	S	t°	S
13	0·74	12	6·46	25	0·09
25	1·08	31	1·28	34	0·12
32	1·78	43	1·95	56	0·24
52	3·35	58	3·10	64	0·32

(Gerardin, A. ch. (4) **5.** 148.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Potassium silver chlorate, $KClO_3$, $AgClO_3$.

(Pfaundler, W. A. B. **46, 2.** 266.)

Rubidium chlorate, $RbClO_3$.

100 pts. H_2O dissolve 2·8 pts. at 4·7°; 3·9 pts. at 13°; 4·9 pts. at 18·2°; 5·1 pts. at 19°. (Reissig, A. **127.** 33.)

Silver chlorate, $AgClO_3$.

Sol. in 10-12 pts. cold H_2O (Vauquelin); in 8-10 pts. cold, and 2 pts. hot H_2O (Chevenix); in 5 pts. cold H_2O (Wächter). Sl. sol. in alcohol (Chevenix); easily sol. in alcohol (Wächter).

Silver chlorate ammonia, $AgClO_3$, $2NH_3$.

Easily sol. in H_2O or alcohol. (Wächter, **1843.**)

Sodium chlorate, $NaClO_3$.

Deliquescent.

Sol. in 3 pts. cold, and less hot H_2O. (Wächter; Chevenix.)

Sol. in 3 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O dissolve 35·5 pts. $NaClO_3$. (Ure's Dict.)

100 pts. H_2O dissolve at:

0°	20°	40°	60°	
81·9	99	123·5	147·1	pts. $NaClO_3$,

80°	100°	120°	
175·6	232·6	333·3	pts. $NaClO_3$.

100 pts. H_2O dissolve 89·3 pts. $NaClO_3$ at 12°. (Schlösing.)

Sat. solution boils at 132°, and temp. can be raised to 135° by supersaturation. (Kremers, Pogg. **97.** 4.)

Sp. gr. of $NaClO_3+Aq$, containing:

10	15	20	25	30	35 % $NaClO_3$.
1·070	1·108	1·147	1·190	1·235	1·282

(Gerlach, Z. anal. **8.** 290.)

Sp. gr. of $NaClO_3+Aq$ at 20° containing 1 mol. $NaClO_3$ in 100 mols. $H_2O=1·03844$. (Nicol, Phil. Mag. (5) **16.** 122.)

$NaClO_3+NaCl$.

100 pts. H_2O dissolve 50·75 pts. $NaClO_3+$ 24·4 pts. NaCl at 12°; 100 pts. H_2O dissolve 249·6 pts. $NaClO_3+11·5$ pts. NaCl at 122°, and when cooled to 12° contain 68·6 pts. $NaClO_3+$ 11·5 pts. NaCl. (Schlösing, C. R. **73.** 1272.)

Sol. in 34 pts. alcohol of 83 % at 16° and in less hot alcohol. (Wittstein.)

Somewhat more easily sol. in alcohol than NaCl. (Berzelius.)

Strontium chlorate, $Sr(ClO_3)_2+5H_2O$.

Very deliquescent, and sol. in H_2O. (Topsoë, W. A. B. **66, 2.** 29.)

Easily sol. in H_2O, less in alcohol, but more sol. in alcohol than $SrCl_2$. (Souchay, A. **102.** 381.)

Insol. in absolute alcohol. (Wächter.)

Thallous chlorate, $TlClO_3$.

Sol. in H_2O, but decomp. by heating.

100 pts. H_2O dissolve at:

0°	20°	50°	80°	100°	
2·80	3·92	12·67	36·65	57·31	pts. $TlClO_3$.

(Muir, Chem. Soc. **29.** 857.)

1 l. $TlClO_3+Aq$ sat. at 10° contains 25·637 g. $TlClO_3$. (Roozeboom, Z. phys. Ch. **8.** 532.)

Ytterbium chlorate.

Sol. in H_2O. (Popp, A. **131.** 179.)

Yttrium chlorate, $Y(ClO_3)_3+8H_2O$.

Deliquescent. Easily sol. in alcohol. Sl. sol. in ether. (Cleve.)

Zinc chlorate, $Zn(ClO_3)_2+6H_2O$.

Very deliquescent. Easily sol. in H_2O and alcohol. Melts in crystal H_2O at 60°. (Vauquelin, A. ch. **95.** 113.)

*Per*chloric acid.

See **Perchloric acid.**

Chlorides.

Most chlorides are sol. in H_2O; a few, however, are insol. or nearly so therein, the chief of which are AgCl, Hg_2Cl_2, Cu_2Cl_2, $PtCl_2$, and AuCl. Several chlorides are decomp. into insol. basic salts or hydroxides, either by the addition of H_2O, as in the case of $BiCl_3$ and $SbCl_3$, or on evaporating the aqueous solution, as $AlCl_3$, $ZnCl_2$, $MgCl_2$, etc.

Some chlorides are sol. in alcohol or ether. *See* under each element.

Chlorine, Cl_2.

The maximum solubility of Cl in H_2O is at 10° (Schönfeld); at 8-10° (Gay-Lussac); at 9-10° (Pelouze).

Solubility decreases from 9-0°; at 100° the solubility=0. (Gay-Lussac.)

Cl_2+Aq sat. at 6° has sp. gr.=1·003. (Berthelot.)

1 vol. H_2O at t° absorbs vols. Cl reduced to 0° and 760 mm. pressure.

t°	Vols. Cl	t°	Vols. Cl
10	2·5852	26	1·9099
11	2·5413	27	1·8695
12	2·4977	28	1·8295
13	2·4543	29	1·7895
14	2·4111	30	1·7499
15	2·3681	31	1·7104
16	2·3253	32	1·6712
17	2·2828	33	1·6322
18	2·2405	34	1·5934
19	2·1984	35	1·5550
20	2·1565	36	1·5166
21	2·1148	37	1·4785
22	2·0734	38	1·4406
23	2·0322	39	1·4029
24	1·9912	40	1·3655
25	1·9504	...	...

(Schönfeld, A. **93**. 26.)

1 vol. H_2O absorbs vols. Cl at t° (not corrected).

Vols. Cl	t°	Vols. Cl	t°	Vols. Cl	t°
1·43	0	3·04	8	1·19	50
1·52	3	3·00	10	0·71	70
2·08	6·5	2·37	17	0·15	100
2·17	7	1·61	35	...	...

(Gay-Lussac, A. ch. (3) **7**. 124.)

1 vol. H_2O at 8° absorbs 3·04 vols. Cl, which is the maximum of solubility. At 50°, 1·09 vols. are absorbed; and at 0°, 1·5 vols. (Pelouze and Fremy.)

1 vol. H_2O at t° dissolves vols. Cl (not corrected).

t°	Vols. Cl	t°	Vols. Cl	t°	Vols. Cl
0	1·75-1·80	12	2·50-2·60	40	1·55-1·60
9	2·70-2·75	14	2·45-2·50	50	1·15-1·20
10	2·70-2·75	30	2·00-2·10	70	0·60-0·65

(Pelouze, A. ch. (3) **7**. 188.)

1 vol. H_2O absorbs vols. Cl at t°.

t°	Vols. Cl	t°	Vols. Cl	t°	Vols. Cl
0	1·5 -1·6	9	2·65-2·70	14	2·6 -2·65
5	2·05-2·1	10	2·9 -3·0	16	2·35-2·4
8	2·5 -2·6	12	2·65-2·75	30	1·8 -1·85

(Riegel and Walz, Berz. J. B. **1846**. 72.)

Solubility in H_2O : α = coefficient of solubility.

t°	α	t°	α	t°	α
6·9	2·2931	10·1	2·8741	21·7	2·0422
8·4	2·5469	11·2	2·7267	32·1	1·5766
9·3	2·7135	13·7	2·5079	36·7	1·3802

(Goodwin, B. **15**. 3040.)

Goodwin also gives tables for solubility of Cl in HCl and various chlorides, but they do not show evidence of accurate work. (A. M. C.)

1 l. HCl+Aq (38 % HCl) dissolves 7·3 g. Cl; 1 l. HCl+Aq (12 % HCl) dissolves 11 g. Cl; 1 l. HCl+Aq (3 % HCl) dissolves 6·5 g. Cl. (Berthelot, C. R. **91**. 191.)

Solubility of Cl in NaCl+Aq. α = coefficient of solubility.

NaCl = 9·97 %.

t°	α	t°	α
7·9	1·8115	18·8	1·2785
11·9	1·5879	22·6	1·0081
15·4	1·3684	...	...

NaCl = 16·01 %.

t°	α	t°	α
6	1·5866	21·4	0·8732
11·6	1·2227	26·9	1·7017
16·4	1·0121	...	...

NaCl = 19·66 %.

t°	α	t°	α
0	1·6978	15·4	0·9511
9·2	1·2145	20·4	0·7758
9·3	1·2068	21·9	0·7385
14·8	0·9740	...	...

(Kumpf, W. Ann. Beibl. **6**. 276.)

Sat. KCl+Aq absorbs $\frac{1}{3}$ less Cl at 15° than pure H_2O. (Dettmer, A. **38**. 35.)

1 l. of a solution of $CaCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2·45 g. Cl at 12°.

1 l. of a solution of $MgCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2·33 g. Cl at 12°.

1 l. of a solution of $MnCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2·00 g. Cl at 12°.

Sl. sol. in KOH+Aq. (Fremy.)

1 mol. $CrOCl_2$ dissolves at 0°, 0·70 atom Cl; at −14°, 1·24 atoms; at −21°, 2·31 atoms; and at −24, 3·00 atoms Cl. (Roozeboom, R. t. c. **4**. 379.)

Sulphuryl chloride absorbs 71 vols. Cl or 0·136 pt. Cl by weight at 0°. (Schulze, J. pr. (2) **27**. 168.)

Insol. in benzene. (Moride.)

Sl. sol. in chloral and iodal. (Dumas.)

Sol. in perchlorethylene. (Faraday.)

Sol. in a very large quantity of ether with decomp.

Chlorine *mon*oxide, Cl_2O.

Sol. in H_2O. At 0°, H_2O absorbs at least 200 times its volume of Cl_2O gas.

Chlorine *tri*oxide, Cl_2O_3.

Decomp. on air at 57° with explosion.

H_2O absorbs 5-6 vols. Cl_2O_3. (Millon, A. ch. (3) **7**. 298.)

H_2O absorbs at 8·5° and 753 mm. press. 8·591 vols. Cl_2O_3. (Brandan.)

100 g. H_2O dissolve at:

8·5°	and	752·9	mm. press.	4·7655	g. Cl_2O_3.
14°	,,	756·3	,, ,,	5·0117	,,
21°	,,	754	,, ,,	5·4447	,,
93°	,,	760	,, ,,	5·6508	,,

(Brandan, A. **151**. 340.)

Does not exist, and above data are for mixture of ClO_2 and Cl. (Garzarolli-Thurnlakh, A. **209**. 184.)

Chlorine *per*oxide, ClO_2.

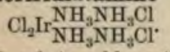
H_2O at 4° absorbs about 20 vols. ClO_2 with formation of $HClO_2$ and $HClO_3$.

H_2SO_4 at $-18°$ absorbs about 20 vols. ClO_2. (Millon, A. ch. (3) **7**. 285.)

Chlorine oxide, Cl_6O_{17}.

Very easily decomp. (Millon, A. **46**. 281.) Probably a mixture of ClO_2 and O.

Chloriridi*di*amine chloride,



$Cl_2Ir\substack{NH_3NH_3Cl \\ NH_3NH_3Cl}$.

Sl. sol. in cold, easily in hot H_2O. (Skoblikoff, A. **84**. 275.)

—— **nitrate**, $Cl_2Ir(N_2H_6NO_3)_2$.

Sol. in H_2O.

—— **sulphate**, $Cl_2Ir(N_2H_6)_2SO_4$.

Sl. sol. in cold, much more easily in hot H_2O.

Chloriridic acid.

Chloriridates.

Most of the chloriridates are very difficultly sol. in H_2O, but a little more sol. than the corresponding chloroplatinates. Insol. or nearly so in alcohol, but not so difficultly sol. as the chloroplatinates. (Rose.)

Ammonium chloriridate, $(NH_4)_2IrCl_6$.

Sol. in 20 pts. cold H_2O (Vauquelin); sl. sol. in cold, much more in hot H_2O (Claus); sol. in HCl+Aq (Soblewsky); insol. in cold NH_4Cl+Aq (Claus); insol. in alcohol (Berzelius).

Lithium chloriridate, Li_2IrCl_6.

Somewhat deliquescent; very sol. in H_2O. (Antony, Gazz. ch. it. **23, 1**. 190.)

Potassium chloriridate, K_2IrCl_6.

Sl. sol. in cold H_2O; sol. in 15 pts. boiling H_2O; less sol. in H_2O containing HCl; insol. in alcohol or sat. KCl, and $CaCl_2$+Aq.

Sodium chloriridate, $Na_2IrCl_6+6H_2O$.

Easily sol. in H_2O; sol. in alcohol of 0·837 sp. gr.

Chloriridium pentamine comps.

See **Irido*pent*amine chloro comps.**

Chloriridosulphurous acid.

Potassium chloriridosulphite, $K_4Ir_2Cl_2(SO_3)_4$, $4KCl+12H_2O$.

Insol. in cold, decomp. by hot H_2O.

$K_4Ir_2Cl_2(SO_3)_4$, $2K_2SO_3$. Decomp. by H_2O.

$Cl_2Ir_2(SO_3)_2$, $8KCl+4H_2O$. Sol. in H_2O; insol. in alcohol. (Claus, J. pr. **42**. 354.)

Chloriridous acid.

Ammonium chloriridite, $(NH_4)_6Ir_2Cl_{12}+3H_2O$.

Sol. in H_2O. (Claus.)

Potassium chloriridite, $K_6Ir_2Cl_{12}+6H_2O$.

Easily sol. in H_2O; insol. in alcohol; insol. in sat. KCl+Aq. (Berzelius.)

Silver chloriridite, $Ag_6Ir_2Cl_{12}$.

Insol. in H_2O or acids; sl. sol. in NH_4OH+Aq.

Sodium chloriridite, $Na_6Ir_2Cl_{12}+24H_2O$.

Efflorescent; sol. in ½ pt. H_2O. Insol. in alcohol. Melts in crystal H_2O at 50°.

Chloro*tetr*amine chromium comps.

See **Chlorotetramine chromium comps.**

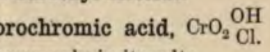
Chlorobromo comps:

See **Bromochloro comps.**

Chlorocarbonic acid.

See **Carbonyl chloride.**

Chlorochromic acid,

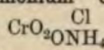


$CrO_2\substack{OH \\ Cl}$.

Known only in its salts.

CrO_2Cl_2. *See* **Chromyl chloride.**

Ammonium chlorochromate, $NH_4CrO_3Cl=$



$CrO_2\substack{Cl \\ ONH_4}$.

More sol. in H_2O than the K salt. (Peligot, A. ch. **52**. 283.)

Barium chlorochromate chloride, $Ba(CrO_3Cl)_2$, $BaCl_2$.

Deliquescent. Very sol. in H_2O. (Prätorius, A. **201**. 1.)

$+H_2O$. Not deliquescent.

Calcium chlorochromate, $Ca(CrO_3Cl)_2$.

Deliquescent. (Peligot.)

$+5H_2O$. Very deliquescent. (Prätorius.)

Chromous chlorochromate.

See ***Tri*chromyl chloride.**

Cobalt chlorochromate, $Co(CrO_3Cl)_2+9H_2O$.

Deliquescent; melts at 40° in crystal H_2O. (Prätorius.)

Magnesium chlorochromate, $Mg(CrO_3Cl)_2$.

Deliquescent. (Peligot.)

$+9H_2O$. Less deliquescent than the other chlorochromates. (Prätorius, A. **201**. 1.)

Nickel chlorochromate, $Ni(CrO_3Cl)_2+9H_2O$.

Deliquescent; melts in its crystal H_2O at 46-48°. (Prätorius.)

Potassium chlorochromate, $KCrO_3Cl=CrO_2(Cl)OK$.

Sol. in H_2O with decomp. Cryst. from H_2O containing HCl without decomp. (Peligot.)

Sodium chlorochromate, $NaCrO_3Cl$.

Deliquescent. (Peligot.)

$+2H_2O$. Deliquescent. (Prätorius.)

Strontium chlorochromate, $Sr(CrO_3Cl)_2+4H_2O$.
Deliquescent; melts in crystal H_2O at 72°. (Prätorius.)

Thallous chlorochromate, $TlCrO_3Cl$.
Decomp. by H_2O. (Lachaud and Lepierre, C. R. **103**. 198.)

Zinc chlorochromate, $Zn(CrO_3Cl)_2+9H_2O$.
Deliquescent; melts at 37·5° in crystal H_2O. (Prätorius.)

Chlorochromotetrammonium comps.
See **Chlorotetramine chromium comps.**

Chloroctamine cobaltic carbonate, $Cl_4Co_2(NH_3)_8CO_3+2H_2O$.
Very sol. in H_2O. (Vortmann and Blasberg, B. **22**. 2651.)
$Cl_2Co_2(NH_3)_8(CO_3)_2+H_2O$. (Vortmann and Blasberg.)

Chloroferrous acid.

Calcium chloroferrite, CaO, $CaCl_2$, Fe_2O_3.
Insol. in H_2O. (le Chatelier, C. R. **99**. 276.)

***Di*chlorofulminoplatinum,** $Pt_4N_4Cl_2O_{12}H_{22}$ (?).
Insol. in H_2O. (v. Meyer, J. pr. (2) **18**. 305.)

***Tri*chlorofulminoplatinum,** $Pt_4N_4Cl_3(OH)O_{12}H_{24}$ (?).
Insol. in H_2O; sol. in $HCl+Aq$. (v. Meyer.)

***Tetra*chlorofulminoplatinum,** $Pt_4N_4Cl_4O_{12}H_{24}$ (?).
Insol. in H_2O. (v. Meyer.)

Chlorohydroxylonitritoplatin*semidi*amine nitrite, $(OH)ClNO_2Pt(NH_3)_2NO_2$.
Easily sol. in hot H_2O. (Cleve.)

Chlorohydroxyloplatin*di*amine bromide, $\substack{OH\\Cl}Pt(N_2H_6Br)_2$.
Sl. sol. in H_2O.

—— **carbonate,** $\substack{OH\\Cl}Pt(N_2H_6)_2CO_3$.
Insol. in H_2O. (Cleve.)

—— **chloride,** $\substack{OH\\Cl}Pt(N_2H_6Cl)_2$.
Sl. sol. in H_2O. (Cleve.)

—— **chromate,** $\substack{OH\\Cl}Pt(N_2H_6)_2CrO_4$.
Nearly insol. in H_2O.

—— ***di*chromate,** $\substack{OH\\Cl}Pt(N_2H_6)_2Cr_2O_7$.
Ppt. (Cleve.)

—— **nitrate** (Raewsky's nitrate), $\substack{OH\\Cl}Pt(N_2H_6NO_3)_2$.
Sl. sol. in cold, more easily in hot H_2O. (Gerhardt.)

Chlorohyposulphuric acid, $S_2O_5Cl_4$.
See **Sulphur oxy*tetra*chloride.**

Chloromanganic acid.
See **Manganic hydrogen chloride.**

Chloromercurosulphurous acid.

Ammonium chloromercurosulphite, NH_4SO_3HgCl.
Sol. in H_2O. (Barth, Z. phys. Ch. **9**. 205.)

Barium chloromercurosulphite, $Ba(SO_3HgCl)_2$.
Insol. in H_2O. (Barth.)

Potassium chloromercurosulphite, KSO_3HgCl.
Sol. in H_2O. (Barth.)

Sodium chloromercurosulphite, $NaSO_3HgCl+H_2O$.
Very sol. in H_2O. (Barth.)

Chloromolybdenum bromide, $Cl_4Mo_3Br_2+3H_2O$.
Insol. in H_2O and dil. acids; sol. in alcohol.
$+6H_2O$. At first easily sol. in H_2O, but a precipitate soon settles. Can be crystallised from dil. $HBr+Aq$. Sol. in alcohol and ether. (Blomstrand.)

Chloromolybdenum potassium bromide, $Cl_4Mo_3Br_2$, $2KBr+2H_2O$.
Decomp. by H_2O. Can be cryst. from $HBr+Aq$. (Blomstrand.)

Chloromolybdenum chloride, $Cl_4Mo_3Cl_2$ = **molybdenum *di*chloride,** $MoCl_2$.
Insol. in H_2O; easily sol. in $HCl+Aq$ or H_2SO_4+Aq; sl. sol. in HNO_3; sol. in NH_4OH+Aq, $NaOH+Aq$, or $KOH+Aq$, with separation of precipitate on boiling; sol. in alcohol and ether. (Blomstrand, J. pr. **77**. 96.)
$+3H_2O$. Insol. in H_2O.
$+4\frac{1}{2}H_2O$. Insol. in H_2O. (Liechti and Kempe, A. **170**. 351.)
$+6H_2O$. Sol. in H_2O, alcohol, or ether. (Blomstrand.)

Chloromolybdenum potassium chloride, $Cl_4Mo_3Cl_2$, $2KCl+2H_2O$.
Decomp. by pure H_2O; can be recrystallised from $HCl+Aq$. (Blomstrand, J. pr. **77**. 108.)

Chloromolybdenum hydroxide, $Cl_4Mo_3(OH)_2+2H_2O$.
Insol. in H_2O or alcohol. Easily sol. in strong acids if fresh, and washed only with cold H_2O. If washed with warm H_2O, it is less sol. in acids. If precipitated hot, is insol. in acids, even H_2SO_4 or fuming HNO_3. (Blomstrand, J. pr. **77**. 100.)
$+8H_2O$.

Chloromolybdenum iodide, $Cl_4Mo_3I_2+3H_2O$.
Precipitate.
$+6H_2O$. Sol. in H_2O and alcohol.

Chloromolybdenum potassium iodide, $Cl_4Mo_3I_2$, $2KI+2H_2O$.
Decomp. by H_2O. Recryst. from $HI+Aq$. (Blomstrand.)

Chloromolybdenum oxybromide, $Cl_4Mo_3\substack{OH\\Br}+2H_2O$.
Insol. in alcohol. (Blomstrand, J. pr. **77**. 116.)

Chloronitratoplatinamine nitrite, ${}^{\mathrm{Cl}}_{\mathrm{NO_3}}Pt(NH_3NO_2)_2$.

Easily sol. in H_2O.

Chloronitratoplatin*di*amine nitrate, ${}^{\mathrm{Cl}}_{\mathrm{NO_3}}Pt(N_2H_6NO_3)_2$.

Decomp. by H_2O with formation of ${}^{\mathrm{Cl}}_{\mathrm{OH}}Pt[(NH_3)_2NO_3)]_2$.

—— **sulphate,** ${}^{\mathrm{Cl}}_{\mathrm{NO_3}}Pt(N_2H_6)_2SO_4+H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

Chloronitritotetramine cobaltic chloride, $Cl(NO_2)CO(NH_3)_4Cl$.

Not very sol. in cold H_2O. (Jörgensen, Z. anorg. **5**. 195.)

Chloronitritoplatin*semidi*amine chloride, $Cl_2(NO_2)Pt(NH_3)_2Cl$.

100 pts. solution in H_2O sat. at 18° contain 1·8 pts. salt; sat. at 100°, 6 pts.

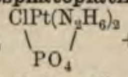
Insol. in abs. alcohol or ether. Not decomp. by conc. HNO_3, HCl, or $H_2C_2O_4$+Aq, and by H_2SO_4 only at a high heat.

Formula given was $PtN_6H_{12}Cl_6O_5$. (Peyrone, J. B. **1855**. 421.)

—— **nitrite,** $Cl_2(NO_2)Pt(NH_3)_2NO_2$.

Sol. in H_2O. (Blomstrand.)

Chlorophosphatoplatin*di*amine phosphate,



$$\begin{matrix} ClPt(N_2H_6)_2 \\ \diagdown \quad \diagup \\ PO_4 \end{matrix} + 2H_2O.$$

Nearly insol. in cold, and only very sl. sol. in hot H_2O. (Raewsky.)

Chloropalladic acid.

Chloropalladates.

The chloropalladates are generally very sol. in H_2O, and sol. in alcohol. (v. Bonsdorff, Pogg. **17**. 264.)

Ammonium chloropalladate, $(NH_4)_2PdCl_6$.

Sl. sol. in H_2O. (Berzelius.)

Barium chloropalladate.

Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cadmium chloropalladate.

As above.

Calcium chloropalladate.

Deliquescent; sol. in H_2O and alcohol. (v. Bonsdorff, **1829**.)

Glucinum chloropalladate, $GlPdCl_6+8H_2O$.

Very hygroscopic, and sol. in H_2O.

Magnesium chloropalladate, $MgPdCl_6+6H_2O$.

Deliquescent; sol. in H_2O.

Nickel chloropalladate, $NiPdCl_6+6H_2O$.

Extremely deliquescent.

Potassium chloropalladate, K_2PdCl_6.

Sl. sol. in cold H_2O. Decomp. by long boiling with H_2O. Sl. sol. in dil. HCl+Aq without decomp. Insol. in NH_4Cl, KCl, or NaCl+Aq. Insol. in alcohol. (Berzelius.)

Zinc chloropalladate, $ZnPdCl_6+6H_2O$.

Very deliquescent. (v. Bonsdorff.)

Chloropalladous acid.

Aluminum chloropalladite, $Al_2Pd_2Cl_{10}+20H_2O$.

Deliquescent. Sol. in H_2O, alcohol, or ether. (Welkow, B. **7**. 804.)

Ammonium chloropalladite, $(NH_4)_2PdCl_4+H_2O$.

Easily sol. in H_2O. Insol. in alcohol. Sol. in NH_4Cl+Aq. (Claus.)

Barium chloropalladite.

Easily sol. in H_2O or alcohol.

Cadmium chloropalladite.

Not deliquescent.

Calcium chloropalladite.

Deliquescent. Sol. in H_2O or alcohol.

Glucinum chloropalladite, $GlPdCl_4+6H_2O$.

Very hygroscopic; very sol. in H_2O, alcohol, or ether. (Welkow.)

Magnesium chloropalladite.

Deliquescent. Easily sol. in H_2O. (v. Bonsdorff.)

Manganese chloropalladite.

Sol. in H_2O and alcohol.

Nickel chloropalladite.

Sol. in H_2O.

Potassium chloropalladite, K_2PdCl_4.

Much more sol. in hot than cold H_2O. (Joannis, C. R. **95**. 295.) Sol. in NH_4OH+Aq. (Berzelius.) Sol. in cold sat. KCl+Aq. (Gibbs, Sill. Am. J. (2) **31**. 70.) Insol. in alcohol. (Wollaston.) Somewhat sol. in alcohol of 0·84 sp. gr., but insol. in absolute alcohol; on boiling decomp. ensues. (Berzelius.)

Sodium chloropalladite.

Deliquescent. Sol. in H_2O and alcohol.

Zinc chloropalladite.

Very deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Chlorophosphoarsenioiridic acid, $2IrCl_3$, $3H_3PO_3$, $3H_3PO_4$, $5H_3AsO_4$ (?).

Very sol. in H_2O. (Geisenheimer.)

Lead chlorophosphoarsenioiridate, $4IrCl_3$, $3Pb_2H_2(PO_3)_2$, $3Pb_3(PO_4)_2$, $5Pb_2H_2(AsO_4)_2$.

Insol. in H_2O.

Chlorophosphoiridic acid, $2IrCl_3$, $3H_3PO_4$, $3H_3PO_3$.

Very sol. in H_2O. Insol. in alcohol. (Geisenheimer, A. ch. (6) **23**. 254.)

$2IrCl_3$, $3H_3PO_4$. Sol. in H_2O and alcohol.

Ammonium chlorophosphoiridate, $2IrCl_3$, $3(NH_4)_3PO_4$, $3(NH_4)_2HPO_3$.

Very deliquescent. Very sol. in H_2O. (Geisenheimer.)

Lead chlorophosphoiridate, $4IrCl_3, 3Pb_3(PO_4)_2, 3PbH_2(PO_3)_2$.

Insol. in H_2O or acetic acid ; very sol. in dil. HNO_3 + Aq. (Geisenheimer.)

Silver chlorophosphoiridate, $2IrCl_3, 3AgH_2PO_4, 3AgH_2PO_3$.

Insol. in H_2O. Sol. in HNO_3 + Aq, and NH_4OH + Aq. (Geisenheimer.)

Chlorophosphoplatinic acid.

See **Chloroplatinophosphoric acid.**

Chloroplatinamine chloride, $Cl_2Pt\genfrac{}{}{0pt}{}{NH_3Cl}{NH_3Cl}$.

Sol. in about 700 pts. H_2O at 0°, and 33-34 pts. at 100°. Not attacked by boiling conc. HNO_3 or H_2SO_4. Sol. in boiling KOH + Aq with decomp. Sol. in NH_4OH + Aq. (Cleve, Sv. V. A. H. **10**, **9**. 30.)

—— **nitrite,** $Cl_2Pt(NH_3NO_2)_2$.

Sl. sol. in cold, easily in hot H_2O.

—— **nitrite silver nitrite,** $Cl_2Pt(NH_3NO_2)_2, AgNO_2$.

Easily sol. in hot, sl. sol. in cold H_2O. (Cleve.)

—— **nitritochloride,** $Cl_2Pt\genfrac{}{}{0pt}{}{NH_3NO_2}{NH_3Cl}$.

Sol. in H_2O. (Cleve.)

Chloroplatin*di*amine bromide, $Cl_2Pt(N_2H_6Br)_2$.

Sl. sol. in hot H_2O. (Cleve.)

—— **chloride (Gros' chloride),** $Cl_2Pt(N_2H_6Cl)_2$.

Nearly insol. in cold, and only sl. sol. in hot H_2O. Sol. in hot conc. KOH + Aq, with decomp. (Grimm.)

Sol. in cold KOH + Aq without decomp. Nearly insol. in NH_4OH + Aq. (Buckton.)

+ H_2O. (Raewsky.)

—— **chloroplatinate,** $Cl_2Pt(N_2H_6Cl)_2, PtCl_4$.

Easily sol. in hot H_2O.

—— **chloroplatinite,** $Cl_2Pt(N_2H_6Cl)_2, PtCl_2$.

Sl. sol. in H_2O. (Cleve.)

—— **chromate,** $Cl_2Pt(N_2H_6)_2CrO_4$.

Nearly insol. in H_2O. (Cleve.)

—— ***di*chromate,** $Cl_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in cold, more sol. in hot H_2O. (Cleve.)

—— **nitrate (Gros' nitrate),** $Cl_2Pt(N_2H_6NO_3)_2$.

Much more easily sol. in hot than in cold H_2O. Sol. in hot KOH + Aq with decomp. Nearly insol. in conc. HNO_3 + Aq.

—— **nitritochloride,** $Cl_2Pt\genfrac{}{}{0pt}{}{N_2H_6NO_2}{N_2H_6Cl}$.

Ppt. (Jörgensen.)

—— **phosphate.**

See **Chlorophosphatoplatin*di*amine phosphate.**

—— **sulphate,** $Cl_2Pt(N_2H_6)_2SO_4$.

Sl. sol. in both cold or hot H_2O. (Cleve.)

+ xH_2O. Sl. sol. in cold, easily in hot H_2O. (Grimm.)

Chloroplatin*di*amine sulphocyanide, $Cl_2Pt(N_2H_6)_2(CNS)_2 + H_2O$.

Ppt. (Cleve.)

Chloroplatin*monodi*amine chloride, $Cl_2Pt\genfrac{}{}{0pt}{}{(NH_3)_2Cl}{NH_3Cl}$.

Quite easily sol. in H_2O. (Cleve.)

Chloroplatin*semidi*amine chloride, $Cl_3Pt(NH_3)_2Cl$.

Sol. in 300 pts. H_2O at 0°, and 65 pts. at 100°. Not decomp. by conc. H_2SO_4. Sol. in KOH + Aq without decomp. (Cleve.)

Chloroplatinic acid, $H_2PtCl_6 + 6H_2O$.

Deliquescent. Sol. in H_2O, alcohol, or ether.

+ $4H_2O$. Deliquescent. (Pigeon, C. R. **112**. 1218.)

$PtCl_4, HCl + 2H_2O$. (Pigeon.)

Aluminum chloroplatinate, $AlCl_3, PtCl_4 + 15H_2O$.

Very sol. in H_2O and alcohol. (Welkow, B. **7**. 304.)

Insol. in ether.

Ammonium chloroplatinate, $(NH_4)_2PtCl_6$.

Sl. sol. in cold, more easily in hot H_2O. (Fresenius.)

100 pts. H_2O dissolve 0·666 pt. at ord. temp. and 12·5 pts. at 100°. (Crookes, C. N. **9**. 37.)

Insol. in cold HCl + Aq. Separates out on cooling from solution in hot HCl, HNO_3, or H_2SO_4. (Fischer.)

Very sl. sol. in cold, easily in hot NH_4OH + Aq. (Fresenius.)

Conc. NH_4Cl + Aq ppts. it almost completely from aqueous solution. (Böttger.)

Sol. in NH_4 succinate + Aq. (Döpping.)

Less sol. in H_2PtCl_6 + Aq than in H_2O. (Rogojski, A. ch. (3) **41**. 452.)

Sol. in $SnCl_2$ + Aq. (Fischer.)

Very sol. with decomp. in KCNS + Aq. (Claus.)

At 15-20°, sol. in 26,535 pts. 97·5 % alcohol, in 1476 pts. 76 % alcohol, and in 665 pts. 55 % alcohol. If free HCl is present, it is sol. in 672 pts. 76 % alcohol. (Fresenius, A. **59**. 118.)

Insol. in absolute alcohol or ether.

Barium chloroplatinate, $BaPtCl_6 + 6H_2O$.

Permanent ; sol. in H_2O ; decomp. by alcohol. (v. Bonsdorff, Pogg. **17**. 250.)

Cadmium chloroplatinate, $CdPtCl_6 + 6H_2O$.

Deliquescent, and easily sol. in H_2O. (v. Bonsdorff.)

Cæsium chloroplatinate, Cs_2PtCl_6.

100 pts. H_2O dissolve at :

0°	10°	20°	30°	40°	50°
0·024	0·050	0·079	0·110	0·142	0·177 pts. Cs_2PtCl_6,

60°	70°	80°	90°	100°
0·213	0·251	0·291	0·332	0·377 pts. Cs_2PtCl_6.

(Bunsen, Pogg. **113**. 337.)

Sol. in 1308 pts. H_2O at 15°, and 261 pts. at 100°. (Crookes, C. N. **9**. 205.)

Calcium chloroplatinate, $CaPtCl_6 + 8H_2O$.
Deliquescent; easily sol. in H_2O. (v. Bonsdorff.)

Cerium chloroplatinate, $CeCl_3$, $PtCl_4 + 13H_2O$.
Deliquescent; very sol. in H_2O or alcohol; insol. in ether. (Marignac.)
$4CeCl_3$, $3PtCl_4 + 8H_2O$. Deliquescent; easily sol. in H_2O or alcohol; insol. in ether. (Holzmann, J. pr. **84.** 80.)

Chromium chloroplatinate, $CrCl_3$, $PtCl_4 + 10\frac{1}{2}H_2O$.
Deliquescent. (Nilson, B. **9.** 1056.)

Cobalt chloroplatinate, $CoPtCl_6 + 6H_2O$.
Very deliquescent. (Jörgensen.)

Copper chloroplatinate, $CuPtCl_6 + 6H_2O$.
Deliquescent in moist air. (v. Bonsdorff.)

Didymium chloroplatinate, $DiCl_3$, $PtCl_4 + 13H_2O$.
Less deliquescent than the cerium salt. (Marignac.)
$+10\frac{1}{2}H_2O$. Deliquescent. (Cleve, Bull. Soc. (2) **43.** 361.)

Erbium chloroplatinate, $ErCl_3$, $PtCl_4 + 11H_2O$.
Very deliquescent. (Cleve.)

Glucinum chloroplatinate, $GlPtCl_6 + 8H_2O$.
Deliquescent in moist air. Very sol. in H_2O, moderately in alcohol. Insol. in ether. (Welkow, B. **6.** 1288.)

Indium chloroplatinate, $2InCl_3$, $5PtCl_4 + 36H_2O$.
Deliquescent. (Nilson.)

Ferrous chloroplatinate, $FePtCl_6 + 6H_2O$.
Deliquescent. (Topsoë.)

Ferric chloroplatinate, $FeCl_3$, $PtCl_4 + 10\frac{1}{2}H_2O$.
Deliquescent. (Nilson.)

Lanthanum chloroplatinate, $LaCl_3$, $PtCl_4 + 13H_2O$.
Deliquescent; extremely sol. in H_2O. (Cleve.)

Lead chloroplatinate, $PbPtCl_6 + 3H_2O$.
Easily sol. in H_2O and alcohol (Topsoë), with decomp. (Birnbaum, Zeit. Ch. **1867.** 520.)

Lithium chloroplatinate, $Li_2PtCl_6 + 6H_2O$.
Extremely deliquescent (Jörgensen); efflorescent. Easily sol. in H_2O, alcohol, or ether-alcohol; insol. in ether. (Scheibler.)

Magnesium chloroplatinate, $MgPtCl_6 + 6H_2O$.
Sol. in H_2O and abs. alcohol.
$+12H_2O$. Sol. in H_2O.

Manganese chloroplatinate, $MnPtCl_6 + 6H_2O$.
Not deliquescent; sol. in H_2O.
$+12H_2O$. Sl. efflorescent.

Nickel chloroplatinate, $NiPtCl_6 + 6H_2O$.
Sol. in H_2O.

Potassium chloroplatinate, K_2PtCl_6.
100 pts. H_2O dissolve at:

0°	10°	20°	30°	40°	50°	
0·74	0·90	1·12	1·41	1·76	2·17	pts. K_2PtCl_6,
60°	70°	80°	90°	100°		
2·64	3·19	3·79	4·45	5·18		pts. K_2PtCl_6.

(Bunsen, Pogg. **113.** 337.)

100 pts. H_2O dissolve 0·926 pt. at 15°, and 5·26 pts. at 100°. (Crookes, C.N. **9.** 205.)
Not attacked by cold conc. H_2SO_4. (Lassaigne.)
Sl. sol. in cold, more easily in hot dil. acids. Less sol. in KCl + Aq than in H_2O, and nearly insol. in sat. KCl + Aq. (Schrötter, W. A. B. **50, 2.** 268.)
Sol. in KOH + Aq. Insol. in cold or hot alkali carbonates or bicarbonates + Aq. (Rose.)
Easily sol. in warm $Na_2S_2O_3$ + Aq. (Himly.)
Sol. in NH_4Cl + Aq. (Brett.)
Sol. in NH_4 succinate + Aq. (Döpping.)
At 15-20°, sol. in 12,083 pts. absolute alcohol, in 3775 pts. 76 % absolute alcohol, and in 1053 pts. 55 % absolute alcohol. (Fresenius.)
Sol. in 1835 pts. 76 % alcohol containing HCl at 15-20°. (Fresenius.)
Nearly absolutely insol. in alcohol containing ether.
Sol. in 42,600 pts. absolute alcohol. (Precht, Z. anal. **18.** 509.)

Rubidium chloroplatinate, Rb_2PtCl_6.
100 pts. H_2O dissolve at:

0°	10°	20°	30°	40°	50°	
0·184	0·154	0·141	0·145	0·166	0·203	pts. Rb_2PtCl_6,
60°	70°	80°	90°	100°		
0·253	0·329	0·417	0·521	0·634		pts. Rb_2PtCl_6.

(Bunsen, Pogg. **113.** 337.)

Sol. in 740 pts. H_2O at 15°, and 157 pts. at 100°. (Crookes, C. N. **9.** 205.)
Insol. in alcohol.

Samarium chloroplatinate, $SmCl_3$, $PtCl_4 + 10\frac{1}{2}H_2O$.
Deliquescent. Very sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 165.)

Silver chloroplatinate, Ag_2PtCl_6.
Ppt. Gradually decomp. by H_2O into AgCl and $PtCl_4$. (Jörgensen, J. pr. (2) **16.** 345.)
$Ag_2PtCl_4(OH)_2$. Ppt.

Silver chloroplatinate ammonia, Ag_2PtCl_6, $2NH_3$.
Insol. in H_2O. (Birnbaum.)

Sodium chloroplatinate, $Na_2PtCl_6 + 6H_2O$.
Easily sol. in H_2O or alcohol; sol. in NaCl + Aq. Insol. in ether. More sol. in absolute alcohol than in 95 % alcohol. (Precht, Z. anal. **18.** 502.)

Strontium chloroplatinate, $SrPtCl_4 + 8H_2O$.
Very sol. in H_2O.

Thallium chloroplatinate, Tl_2PtCl_6.
Very sl. sol. in H_2O. Sol. in 15,585 pts. H_2O at 15°, and 1948 pts. at 100°. (Crookes.)

Thorium chloroplatinate, $ThCl_4$, $PtCl_4 + 12H_2O$.
Very deliquescent. (Cleve, Bull. Soc. (2) **21.** 118.)

Stannic chloroplatinate, $SnCl_4$, $PtCl_4 + 12H_2O$.
(Nilson, B. **9.** 1142.)

Vanadyl chloroplatinate, $(VO)PtCl_4 + 10\frac{1}{2}H_2O$.
Sol. in H_2O; cryst. from $PtCl_4$ + Aq. (Brauner, M. **3.** 58.)

Yttrium chloroplatinate, $4YCl_3$, $5PtCl_4+52H_2O$.

Very deliquescent. (Cleve.)

$2YCl_3$, $3PtCl_4+30H_2O$. (Nilson, B. **9.** 1059.)

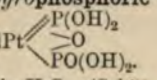
$2YCl_3$, $PtCl_4+21H_2O$. (Nilson.)

Zinc chloroplatinate, $ZnPtCl_6+6H_2O$.

Deliquescent; sol. in H_2O and alcohol.

Zirconyl chloroplatinate, $(ZrO)PtCl_6+12H_2O$. (Nilson.)

Chloroplatinoanhydro*pyro*phosphoric acid, $ClPtP_2O_6H_4$=



$$\mathrm{ClPt}\begin{array}{l}=\mathrm{P(OH)_2}\\ >\mathrm{O}\\ \backslash\mathrm{PO(OH)_2}.\end{array}$$

Not deliquescent. Sol. in H_2O. (Schützenberger, Bull. Soc. (2) **18.** 154.)

Chloroplatinocyanhydric acid, $H_2Pt(CN)_4Cl_2$.

See **Perchloroplatinocyanhydric acid.**

Potassium chloroplatinocyanide, $5K_2Pt(CN)_4$, $K_2Pt(CN)_4Cl_2+21H_2O$.

Sol. in H_2O; insol. in alcohol.

Chloroplatinophosphoric acid, $Cl_2PtP(OH)_3$.

Very deliquescent, and sol. in H_2O. (Schützenberger, Bull. Soc. (2) **17.** 493.)

Lead chloroplatinophosphate, $Pb_3(Cl_2PtPO_3)_2+8H_2O$.

Ppt.

$Pb_3(Cl_2PtPO_3)_2$, $2PbO+4H_2O$. Ppt. (Schützenberger, Bull. Soc. (2) **17.** 494.)

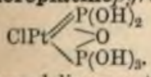
Silver chloroplatinophosphate, Ag_2HPO_3, $PtCl_2$.

Ppt. (Schützenberger, Bull. Soc. (2) **17.** 494.)

Chloroplatino*di*phosphoric acid, $PtCl_2$, $P_2(OH)_6$.

Very deliquescent, and easily sol. in H_2O. (Schützenberger, Bull. Soc. (2) **18.** 153.)

Chloroplatino*pyro*phosphoric acid,



$$\mathrm{ClPt}\begin{array}{l}=\mathrm{P(OH)_2}\\ >\mathrm{O}\\ \backslash\mathrm{P(OH)_3}.\end{array}$$

Less deliquescent than chloroplatino*di*phosphoric acid.

Chloroplatinous acid, H_2PtCl_4.

Known only in solution, and as the basic compound—

$H_2Pt(OH)Cl_3+H_2O$. (Nilson, J. pr. (2) **15.** 260.)

Aluminum chloroplatinite, $AlPtCl_5+10\frac{1}{2}H_2O$.

Very deliquescent; sol. in H_2O. (Nilson, J. pr. (2) **15.** 260.)

Ammonium chloroplatinite, $(NH_4)_2PtCl_4$.

Sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. (Peyrone, A. **55.** 206.)

Barium chloroplatinite, $BaPtCl_4+3H_2O$.

Not deliquescent; sol. in H_2O. Very sl. sol. in 93 % alcohol.

Cadmium chloroplatinite ammonia, $CdPtCl_4$, $4NH_3$.

Insol. in H_2O or NH_4OH+Aq. Sol. in HCl+Aq. (Thomsen, B. **2.** 668.)

Cæsium chloroplatinite, Cs_2PtCl_4.

Sl. sol. in cold, easily in hot H_2O.

100 pts.	H_2O dissolve	3·4	pts.	salt at	20°
,,	,,	6·73	,,	,,	40°
,,	,,	8·68	,,	,,	60°
,,	,,	10·92	,,	,,	80°
,,	,,	12·10	,,	,,	100°.

(Godeffroy, A. **181.** 176.)

Calcium chloroplatinite, $CaPtCl_4+8H_2O$.

Deliquescent; sol. in H_2O.

Cerium chloroplatinite, $CeCl_3$, $2PtCl_2+10\frac{1}{2}H_2O$.

Deliquescent; easily sol. in H_2O. (Nilson, B. **9.** 1847.)

Chromium chloroplatinite, $Cr_2Pt_3Cl_{12}+18H_2O$.

Deliquescent.

Cobalt chloroplatinite, $CoPtCl_4+6H_2O$.

Sl. deliquescent in moist, efflorescent in dry air.

Copper chloroplatinite, $CuPtCl_4+6H_2O$.

Permanent.

Copper chloroplatinite ammonia (**cuprammonium chloroplatinite**), $Cu(NH_3)_4PtCl_4$.

Insol. in H_2O or NH_4OH+Aq; easily sol. in H_2SO_4+Aq. (Millon and Commaille, C. R. **57.** 822.)

Didymium chloroplatinite, $DiCl_3$, $2PtCl_2+10H_2O$.

Deliquescent; very sol. in H_2O. (Nilson.)

$2DiCl_3$, $3PtCl_2+18H_2O$. As above. (Nilson.)

Erbium chloroplatinite, $ErPtCl_5+13\frac{1}{2}H_2O$.

Deliquescent.

$Er_2Pt_3Cl_{12}+24H_2O$. Deliquescent in moist air.

Glucinum chloroplatinite, $GlPtCl_4+5H_2O$.

Deliquescent in moist air.

Ferrous chloroplatinite, $FePtCl_4+7H_2O$.

Deliquescent.

Lanthanum chloroplatinite, $La_2Pt_3Cl_{12}+18$, and $27H_2O$.

Deliquescent.

Lead chloroplatinite, $PbPtCl_4$.

Insol. in cold H_2O.

Lithium chloroplatinite, $Li_2PtCl_4+6H_2O$.

Sol. in H_2O.

Magnesium chloroplatinite, $MgPtCl_4+6H_2O$.

Not very deliquescent; very sol. in H_2O.

Manganese chloroplatinite, $MnPtCl_4+6H_2O$.

As the Mg salt.

Mercurous chloroplatinite.

Ppt.

Nickel chloroplatinite, $NiPtCl_4+6H_2O$.

As the Co salt.

Potassium chloroplatinite, K_2PtCl_4.

Moderately sol. in H_2O ; insol. in alcohol.

Rubidium chloroplatinite, Rb_2PtCl_4.

Sl. sol. in cold ; easily in hot H_2O.

Silver chloroplatinite, Ag_2PtCl_4.

Insol. in H_2O. NH_4OH+Aq dissolves out AgCl. (Lang.)

AgCl, $PtCl_2$ (?). As above. (Commaille, Bull. Soc. (2) **6.** 262.)

Silver chloroplatinite ammonia, Ag_2PtCl_4, $4NH_3$.

(Thomsen.)

Sodium chloroplatinite, $Na_2PtCl_4+4H_2O$.

Deliquescent ; very sol. in H_2O.

Strontium chloroplatinite, $SrPtCl_4+6H_2O$.

Deliquescent.

Thallium chloroplatinite, Tl_2PtCl_4.

Sol. in much hot H_2O.

Thorium chloroplatinite, $Th_2Pt_3Cl_{14}+24H_2O$.

Very deliquescent.

Yttrium chloroplatinite, $Y_2Pt_3Cl_{12}+24H_2O$.

Deliquescent.

Zinc chloroplatinite, $ZnPtCl_4+6H_2O$.

Sl. sol. in cold, more easily in hot H_2O ; insol. in alcohol.

Zinc chloroplatinite ammonia, $ZnPtCl_4$, $4NH_3$.

Sl. sol. in H_2O ; easily sol. in $HCl+Aq$. Insol. in alcohol. (Thomsen, J. B. **1868.** 278.)

Zirconyl chloroplatinite, $(ZrO)PtCl_4+8H_2O$.

(Nilson.)

Chloroplatosulphurous acid.

Ammonium chloroplatosulphite, acid, $NH_4PtClSO_3$, $H_2SO_3+4H_2O$.

Sol. in H_2O. (Birnbaum, A. **152.** 149.)

Ammonium chloroplatosulphite chloride sulphite, $NH_4PtClSO_3$, $(NH_4)_2SO_3$, NH_4Cl.

Very deliquescent. (Birnbaum.)

Ammonium chloroplatosulphite sulphite, $NH_4ClPtSO_3$, $(NH_4)_2SO_3+3H_2O$.

Sol. in H_2O. (Birnbaum.)

Barium chloroplatosulphite chloride ammonium chloride, $Ba(ClPtSO_3)_2$, $Ba(PtClSO_3)(Cl)$, $6NH_4Cl+3H_2O$.

Sol. in H_2O. (Birnbaum.)

Potassium chloroplatosulphite ammonium chloride, $KPtClSO_3$, $2NH_4Cl$.

Very deliquescent. (Birnbaum, A. **152.** 142.)

Potassium chloroplatosulphite chloride, $KPtClSO_3$, 2KCl.

Deliquescent ; sol. in H_2O. (Birnbaum, A. **152.** 145.)

Potassium chloroplatosulphite ammonium potassium sulphite, $KPtClSO_3$, $(NH_4)KSO_3+3H_2O$.

Very deliquescent. (Birnbaum, A. **159.** 120.)

Sodium chloroplatosulphite ammonium chloride, $NaPtClSO_3$, $2NH_4Cl$.

Very deliquescent. (Birnbaum, A. **159.** 117.)

Chloroplumbic acid.

Ammonium chloroplumbate.

Insol. in conc. NH_4Cl+Aq. (Nikoljukin, B. **18.** 370 R.)

$5NH_4Cl$, $2PbCl_4$. Not hygroscopic. Decomp. by H_2O with pptn. of PbO_2. Sol. in $HCl+Aq$ and in cold HNO_3+Aq without decomp. (Classen and Zahorski, Z. anorg. **4.** 100.)

Composition is $2NH_4Cl$, $PbCl_4$. (Friedrich, W. A. B. **102, 2b.** 527.)

Cæsium chloroplumbate, Cs_2PbCl_6.

Nearly absolutely insol. in conc. $CsCl+Aq$ in presence of Cl. (Wells, Z. anorg. **4.** 335.)

1 ccm. conc. $HCl+Aq$ containing $PbCl_4$ dissolves 0·000049 g. Cs_2PbCl_6. (Wells, Z. anorg. **4.** 341.)

Potassium chloroplumbate, K_2PbCl_6.

Decomp. by H_2O ; sol. in $KCl+Aq$. (Wells, Z. anorg. **4.** 335.)

Rubidium chloroplumbate, Rb_2PbCl_6.

Decomp. by H_2O ; sl. sol. in conc. $RbCl+Aq$. (Wells, Z. anorg. **4.** 335.)

1 ccm. conc. $HCl+Aq$ containing $PbCl_4$ dissolves 0·003 g. Rb_2PbCl_6. (Wells, Z. anorg. **4.** 341.)

Chloropurpureochromium bromide, $CrCl(NH_3)_5Br_2$.

Somewhat more easily sol. in H_2O than the chloride. (Jörgensen, J. pr. (2) **20.** 105.)

—— **chloride,** $CrCl(NH_3)_5Cl_2$.

Difficultly sol. in cold, and decomp. by hot H_2O.

1 pt. dissolves in 154 pts. H_2O at 16°. Insol. in conc. $HCl+Aq$. More sol. in dil. H_2SO_4+Aq than in H_2O. Sol. in NH_4OH+Aq without decomp. (Jörgensen, J. pr. (2) **20.** 105.)

—— **mercuric chloride,** $CrCl(NH_3)_5Cl_2$, $3HgCl_2$.

Very difficultly sol. in H_2O. (Jörgensen.)

—— **chloroplatinate,** $CrCl(NH_2)_5(PtCl_6)$.

Extremely difficultly sol. in H_2O. (Jörgensen.)

—— **chromate,** $CrCl(NH_3)_5(CrO_4)$.

Sl. sol. in H_2O ; sl. more sol. than chloropurpureocobalt chromate. (Jörgensen.)

—— **dithionate,** $CrCl(NH_3)_5(S_2O_6)$.

Very sl. sol. in cold, but much more easily in hot H_2O. (Jörgensen.)

—— **ferrocyanide,** $[CrCl(NH_3)_5]_2Fe(CN)_6+4H_2O$.

Very difficultly sol. in cold H_2O. (Jörgensen.)

—— **fluosilicate,** $CrCl(NH_3)_5(SiF_6)$.

Very difficultly sol. in H_2O. Insol. in H_2SiF_6+Aq. (Jörgensen, J. pr. (2) **20.** 105.)

Chloropurpureochromium mercuric iodide, $CrCl(NH_3)_5I_2, 2HgI_2$.

Decomp. by H_2O; sol. in alcohol and warm KCN+Aq.

$CrCl(NH_3)_5I_2, HgI_2$. Very difficultly sol. in cold H_2O; easily sol. in KCN+Aq. (Jörgensen, *l.c.*)

—— **nitrate,** $CrCl(NH_3)_5(NO_3)_2$.

Sol. in 71 pts. H_2O at 17·5°. Insol. in HNO_3+Aq. (Jörgensen.)

—— **oxalate,** $CrCl(NH_3)_5C_2O_4$.

Very sl. sol. in cold H_2O. (Jörgensen, *l.c.*)

—— **sulphate,** $CrCl(NH_3)_5SO_4+2H_2O$.

Sol. in H_2O; precipitated by alcohol. (Jörgensen.)

—— **sulphate, acid,** $[CrCl(NH_3)_5]_4SO_4(HSO_4)_6$.

Quite sol. in H_2O. (Jörgensen, J. pr. (2) **20.** 185.)

—— *penta***sulphide,** $CrCl(NH_3)_5S_5$.

Very sl. sol. in cold, easily sol. in warm H_2O. Decomp. by dil. HCl+Aq. Insol. in alcohol. (Jörgensen.)

Chloropurpureocobaltic bromide, $CoCl(NH_3)_5Br_2$.

Properties resemble the chloride very closely. Sol. in 214 pts. H_2O at 14·3° (Jörgensen, J. pr. (2) **18.** 205.)

—— **mercuric bromide,** $4CoCl(NH_3)_5Br_2, 9HgBr_2$.

Ppt. (J.)

—— **bromoplatinate,** $CoCl(NH_3)_5Br_2, PtBr_4$.

Very sl. sol. in H_2O. (J.)

—— **carbonate,** $CoCl(NH_3)_5CO_3+4\frac{1}{2}H_2O$.

Efflorescent; very easily sol. in H_2O. (J.)

—— **chloride,** $CoCl(NH_3)_5Cl_2$.

Very sl. sol. in cold, more easily in hot H_2O. Sol. in 244 pts. H_2O at 15·5°. (Claudet, Phil. Mag. J. (4) **2.** 253.) In 287 pts. H_2O at 10·2° and 255 pts. at 11·5°. (Rose, Pogg. **20.** 152.) 100 pts. H_2O dissolve 0·232 pt. $CoCl_3, 5NH_3$, at 0°, and 1·031 pts. at 46·6°. (Kurnakoff, J. Russ. Soc. **24.** 629.)

Sl. decomp. by cold, completely by boiling H_2O; decomp. prevented by a little HCl. Pptd. from aqueous solution by alcohol, HCl, or sat. KCl or NaCl+Aq; not decomp. by boiling HCl+Aq. (Claudet, *l.c.*) Nearly insol. in cold, but sol. in hot H_2O, to which a few drops of HCl have been added. Less sol. in dil. HCl+Aq than luteocobaltic chloride. (Rogojski, A. ch. (3) **41.** 447.)

Insol. in alcohol. (Gibbs and Genth.)

—— **antimony chloride,** $2CoCl(NH_3)_5Cl_2, SbCl_3$.

Ppt. Decomp. by H_2O. (Gibbs.)

—— **bismuth chloride.**

Insol. in conc. HCl. Easily decomp. by H_2O. (Gibbs.)

Chloropurpureocobaltic mercuric chloride, $CoCl(NH_3)_5Cl_2, 3HgCl_2$.

Insol. in cold, less sol. in hot H_2O than chloropurpureocobaltic chloride. Insol. in cold fuming HCl+Aq; sl. sol. in hot HCl+Aq, separating on cooling; sl. sol. in hot aqua regia; moderately sol. in hot HNO_3+Aq; partly sol. in cold conc. H_2SO_4, wholly on warming. Easily sol. in warm $H_2C_2O_4$+Aq. Insol. in $HgCl_2$+Aq.

Moderately sol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq. (Carstanjen.)

$CoCl(NH_3)_5Cl_2, 2HgCl_2$. Sl. sol. in cold, but much more easily in hot H_2O. (Gibbs, Proc. Am. Acad. **10.** 33.)

—— **chloropalladite,** $CoCl(NH_3)_5Cl_2, PdCl_2$.

Sl. sol. in cold, moderately sol. in hot H_2O. (Carstanjen.)

—— **chloroplatinate,** $CoCl(NH_3)_5Cl_2, PtCl_4$.

Nearly insol. in cold. Very sl. sol. in hot H_2O. (Gibbs and Genth, Sill. Am. J. (2) **23.** 319.)

—— **chromate,** $CoCl(NH_3)_5CrO_4$.

Very sl. sol. in H_2O. (J.)

—— *di***chromate,** $CoCl(NH_3)_5Cr_2O_7$.

Much more easily sol. in H_2O than the neutral salt. (J.)

—— **dithionate,** $CoCl(NH_3)_5S_2O_6$.

Very sl. sol. in cold, more easily in hot H_2O. (J.)

—— **manganic fluoride.**

Ppt. Sl. sol. in dil. HF+Aq. (Christensen, J. pr. (2) **35.** 161.)

—— **fluosilicate,** $CoCl(NH_3)_5SiF_6$.

Very sl. sol. in HF+Aq.

—— **iodide,** $CoCl(NH_3)_5I_2$.

Much more sol. in H_2O than bromide or chloride. Sol. in 54·4 pts. H_2O at 15·6°, and 50 pts. at 19·3°. (J.)

—— **mercuric iodide,** $CoCl(NH_3)_5I_2, 2HgI_2$.

Sl. sol. in H_2O. (J.)

$CoCl(NH_3)_5I_2, HgI_2$. Very sl. sol. in cold H_2O. (J.)

—— **nitrate,** $CoCl(NH_3)_5(NO_3)_2$.

Sol. in 80 pts. H_2O at 15°. Rather easily sol. in hot H_2O. (Jörgensen, J. pr. (2) **18.** 209.)

—— **oxalate,** $CoCl(NH_3)_5C_2O_4$.

Sl. sol. in H_2O. (J.)

—— *pyro***phosphate,** $CoCl(NH_3)_5(H_2P_2O_7)$.

Sl. and very slowly sol. in cold, much more easily in warm H_2O. (J.)

$[CoCl(NH_3)_5]_2P_2O_7+xH_2O$. Quite easily sol. in H_2O.

—— *di***phospho***penta***molybdate,** $[CoCl(NH_3)_5]_2(5MoO_3, 2HPO_4)$.

Ppt. Nearly insol. in pure H_2O; more sol. in dil. H_2SO_4+Aq without decomp. (J.)

$[CoCl(NH_3)_5]_2(5MoO_3, 2NH_4PO_4)$. Ppt. As above.

Chloropurpureocobaltic sulphate, $CoCl(NH_3)_5SO_4$.

Anhydrous. Slowly sol. in 128-131·9 pts. H_2O at 16°.

$+2H_2O$. Sol. in 133·4 pts. H_2O at 17·3°. Rather easily sol. in hot H_2O, and much more rapidly than the anhydrous salt. (J.)

$[CoCl(NH_3)_5]_4SO_4(SO_4H)_6$. Decomp. by H_2O into neutral sulphate. Sol. in H_2SO_4.

—— **tartrate,** $CoCl(NH_3)_5(C_4H_5O_6)_2+2\frac{1}{2}H_2O$.

Moderately sol. in H_2O; insol. in alcohol.

—— **thiosulphate,** $CoCl(NH_3)_5S_2O_3$.

Nearly insol. in cold H_2O; very sl. sol. in boiling H_2O with partial decomp. (J.)

Chloropurpureoiridium comps.

See **Irido*pent*amine comps.**

Chloropurpureorhodium carbonate, $ClRh(NH_3)_5CO_3+H_2O$.

Easily sol. in H_2O. (Jörgensen.)

—— **chloride,** $ClRh(NH_3)_5Cl_2$.

Sol. in 179 pts. H_2O at 17°, and more easily in hot H_2O. Sol. in conc. H_2SO_4 or boiling $NaOH+Aq$ without decomp. Very sl. sol. in cold dil. $HCl+Aq$ (1 : 1). Sl. sol. in hot $HCl+Aq$. Insol. in alcohol. (Jörgensen, J. pr. (2) **27.** 433; **34.** 394.)

—— **rhodium chloride,** $3ClRh(NH_3)_5Cl_2, 2RhCl_3$.

Ppt. (Jörgensen, Z. anorg. **5.** 75.)

—— **chloroplatinate,** $ClRh(NH_3)_5PtCl_6$.

Insol. in cold H_2O. (J.)

—— **fluosilicate,** $ClRh(NH_3)_5SiF_6$.

Very sl. sol. in cold H_2O. Sol. in $NaOH+Aq$ as roseo salt. (J.)

—— **hydroxide,** $ClRh(NH_3)_5(OH)_2$.

Known only in solution. (J.)

—— **nitrate,** $ClRh(NH_3)_5(NO_3)_2$.

Sl. sol. in cold H_2O, but more easily than the chloride. Sol. in boiling $NaOH+Aq$ as roseo salt. (J.)

—— **sulphate,** $ClRh(NH_3)_5SO_4+2H_2O$.

Sl. sol. in cold, more easily in hot H_2O. (J.)

$4ClRh(NH_5)_5SO_4, 3H_2SO_4$. Sl. sol. in cold, more easily in hot H_2O. (J.)

Chlororhodous acid.

Ammonium chlororhodite, $(NH_4)_4Rh_2Cl_{10}+2H_2O$.

Sol. in H_2O; insol. in alcohol. (Wollaston.) Not obtainable. (Leidié, A. ch. (6) **17.** 275.)

$(NH_4)_6Rh_2Cl_{12}+3H_2O$. Sol. in H_2O, but less easily than Na salt; insol. in alcohol. Sol. in dil. NH_4Cl+Aq. (Claus, J. B. **1855.** 423.)

Ammonium chlororhodite nitrate, $(NH_4)_6Rh_2Cl_{12}, 2NH_4NO_3$.

Very sol. in H_2O. Decomp. by boiling with H_2O. Sl. sol. in HNO_3+Aq. (Leidié, C. R. **107.** 234.)

Barium chlororhodite, $Ba_3Rh_2Cl_{12}$.

Resembles the Na salt. (Bunsen, A. **146.** 276.)

Lead chlororhodite, $Pb_3Rh_2Cl_{12}$.

Ppt. Insol. in H_2O. (Claus.) Not obtainable. (Leidié.)

Mercurous chlororhodite, $Hg_6Rh_2Cl_{12}$.

Ppt. Insol. in H_2O. (Claus.) Not obtainable. (Leidié.)

Methylamine chlororhodite, $(CH_3NH_3)_6Rh_2Cl_{12}$.

Sol. in H_2O. (Vincent, C. R. **101.** 322.)

***Di*methylamine chlororhodite,** $[(CH_3)_2NH_2]_6Rh_2Cl_{12}+3H_2O$.

Sol. in H_2O. (Vincent.)

***Tri*methylamine chlororhodite,** $[(CH_3)_3NH]_6Rh_2Cl_{12}+9H_2O$.

Easily sol. in H_2O. (Vincent.)

Potassium chlororhodite, $K_4Rh_2Cl_{10}+2H_2O$.

Not efflorescent. Sl. sol. in H_2O. Sl. sol. in $KCl+Aq$. (Gibbs.) Insol. or sl. sol. in alcohol. (Berzelius.)

Salt is anhydrous. (Leidié.)

Contains $2H_2O$. (Seubert and Kobbé, B. **23.** 2556.)

$K_6Rh_2Cl_{12}+6H_2O$. Efflorescent. Sl. sol. in H_2O. Aqueous solution decomp. to above on standing. (Claus.)

Not obtainable. (Leidié.)

Also obtained by Seubert and Kobbé. (B. **23.** 2556.)

$+3H_2O$. (Leidié, C. R. **111.** 106.)

Silver chlororhodite, $Ag_6Rh_2Cl_{12}$.

Ppt. Insol. in H_2O. (Claus.)

Not obtainable. (Leidié.)

Sodium chlororhodite, $Na_6Rh_2Cl_{12}+18H_2O$.

Efflorescent. Sol. in 1·5 pts. H_2O. Melts in crystal H_2O at 50°. Insol. in alcohol. (Claus.)

Chlororuthenic acid.

Ammonium chlororuthenate, $(NH_4)_2RuCl_6$.

Easily sol. in H_2O. (Claus.)

Formula is $(NH_4)_2Ru(NO)Cl_5$. (Joly, C. R. **107.** 994.)

Potassium chlororuthenate, K_2RuCl_6.

Very sol. in H_2O. Very sl. sol. in conc. NH_4Cl+Aq. Insol. in 70 % alcohol. (Claus.)

Formula is $K_2Ru(NO)Cl_5$. (Joly.)

Chlororuthenious acid.

Ammonium chlororuthenite, $(NH_4)_4Ru_2Cl_{10}$.

Sl. sol. in H_2O. Insol. in NH_4Cl+Aq or alcohol. (Claus, J. pr. **80.** 282.)

Potassium chlororuthenite, $K_4Ru_2Cl_{10}$.

Moderately sol. in cold, more easily in hot H_2O. Decomp. easily by heating. Insol. in conc. NH_4Cl+Aq. Insol. in 80 % alcohol.

Sodium chlororuthenite, $Na_4Ru_2Cl_{10}$.

Deliquescent. Sol. in H_2O or alcohol.

*Tri*chlorosilicomercaptane.

See **Silicon chlorohydrosulphide.**

Chlorosmic acid.

Ammonium chlorosmate, $(NH_4)_2OsCl_6$.

Sl. sol. in H_2O. Insol. in alcohol and H_2O containing HCl.

Potassium chlorosmate, K_2OsCl_6.

Properties as the NH_4 salt.

Silver chlorosmate, Ag_2OsCl_6.

Insol. in H_2O or HNO_3 + Aq. (Claus and Jacoby.)

Silver chlorosmate ammonia, $Ag_2OsCl_6, 2NH_3$.

Sol. in much H_2O. Sl. sol. in KOH + Aq. Easily sol. in KCN + Aq. (C. and J.)

Sodium chlorosmate, $Na_2OsCl_6 + 2H_2O$.

Easily sol. in H_2O or alcohol.

Chlorosmious acid.

Ammonium chlorosmite, $(NH_4)_4Os_2Cl_{10} + 3H_2O$.

Easily sol. in H_2O and alcohol; insol. in ether. (Claus and Jacoby, J. pr. **90**. 65.)

Potassium chlorosmite, $K_6Os_2Cl_{12} + 6H_2O$.

Very easily sol. in H_2O or alcohol. Insol. in ether. (C. and J.)

Chloro*pyro*selenious acid.

Ammonium chloro*pyro*selenite, $NH_4Cl, 2SeO_2 + 2H_2O$.

Sol. in H_2O. (Muthmann and Schäfer, B. **26**. 1008.)

Potassium chloro*pyro*selenite, $KCl, 2SeO_2 + 2H_2O$.

As NH_4 salt. (M. and S.)

Rubidium chloro*pyro*selenite, $RbCl, 2SeO_2 + 2H_2O$.

As NH_4 salt. (M. and S.)

Chlorostannic acid, $SnO(OH)Cl$.

(Mallet, Chem. Soc. **35**. 524.)

$H_2SnCl_6 + 6H_2O$. Extremely deliquescent; sol. in H_2O. (Seubert, B. **20**. 793.)

Ammonium chlorostannate, $(NH_4)_2SnCl_6$ (*pink salt*).

Sol. in 3 pts. H_2O at 14·5°. Solution decomp. on boiling when dilute, but not when conc. (Bolley.)

Barium chlorostannate, $BaSnCl_6 + 5H_2O$.

Sol. in H_2O. (Lewy, A. ch. (3) **16**. 308.)

Cæsium chlorostannate, Cs_2SnCl_6.

Nearly insol. in conc. HCl + Aq. (Sharples, Sill. Am. J. (2) **47**. 178.)

Calcium chlorostannate, $CaSnCl_6 + 5H_2O$.

Very deliquescent. (Lewy, A. ch. (3) **16**. 308.)

Cerium chlorostannate, $CeSnCl_7 + 9H_2O$.

Deliquescent. Sol. in H_2O. (Cleve, Bull. Soc. (2) **31**. 197.)

Cobalt chlorostannate, $CoSnCl_6 + 6H_2O$.

Sol. in H_2O. (Jörgensen.)

Didymium chlorostannate, $DiCl_3, SnCl_4 + 10\frac{1}{2}H_2O$.

Sol. in H_2O. (Cleve.)

Glucinum chlorostannate, $GlSnCl_6 + 8H_2O$.

Deliquescent. Sol. in H_2O. (Atterberg, Sv. V. A. Handl. **12**. No. 4. 14.)

Lanthanum chlorostannate, $4LaCl_3, 5SnCl_4 + 45H_2O$.

Deliquescent. Sol. in H_2O. (Cleve.)

Lithium chlorostannate, $Li_2SnCl_6 + 8H_2O$.

Sol. in little H_2O without decomp., but decomp. by dilution. (Chassevant, A. ch. (6) **30**. 42.)

Magnesium chlorostannate, $MgSnCl_6 + 6H_2O$.

Very deliquescent. (Lewy.)

Manganous chlorostannate, $MnSnCl_6 + 6H_2O$.

Deliquescent in moist, efflorescent in dry air. (Jörgensen.)

Nickel chlorostannate, $NiSnCl_6 + 6H_2O$.

Sol. in H_2O. (Jörgensen.)

Potassium chlorostannate, K_2SnCl_6.

Sol. in H_2O.

Sodium chlorostannate, $Na_2SnCl_6 + 6H_2O$.

Easily sol. in H_2O. (Topsoë, Gm. K. Handb. 6^{te} aufl. III. 149.)

Strontium chlorostannate, $SrSnCl_6 + 8H_2O$.

Sl. deliquescent, and easily sol. in H_2O. (Topsoë.)

Yttrium chlorostannate, $YCl_3, SnCl_4 + 8H_2O$.

Sol. in H_2O. (Cleve, Bull. Soc. (2) **31**. 197.)

Chlorosulphonic acid, $HClSO_3$.

See **Sulphuryl hydroxyl chloride.**

Chlorosulphuric acid, HSO_3Cl.

See **Sulphuryl hydroxyl chloride.**

SO_2Cl_2. *See* **Sulphuryl chloride.**

Chlorotelluric acid.

Ammonium chlorotellurate, $(NH_4)_2TeCl_6$.

Sol. without decomp. in a small amt. of H_2O, but decomp. by much H_2O or alcohol.

Cæsium chlorotellurate, Cs_2TeCl_6.

Decomp. by H_2O. Sol. in dil. HCl + Aq.

100 pts. HCl + Aq (sp. gr. 1·2) dissolve 0·05 pt. at 22°.

100 pts. HCl + Aq (sp. gr. 1·05) dissolve 0·78 pt. at 22°.

Insol. in alcohol. (Wheeler, Sill. Am. J. **145**. 267.)

Potassium chlorotellurate, K_2TeCl_6.

Deliquescent; decomp. by H_2O and absolute alcohol. (Berzelius.)

The most sol. in H_2O of the chloro- or bromotellurates. Easily sol. in dil. HCl + Aq; conc. HCl + Aq ppts. KCl. (Wheeler, Sill. Am. J. **145**. 267.)

Rubidium chlorotellurate, Rb_2TeCl_6.

Decomp. by H_2O. Much more sol. in dil. $HCl+Aq$ than Cs_2TeTl_6.

100 pts. $HCl+Aq$ (sp. gr. 1·2) dissolve 0·34 pt. at 22°.

100 pts. $HCl+Aq$ (sp. gr. 1·05) dissolve 13·09 pts. at 22°.

Sl. sol. in alcohol. (Wheeler.)

Chlorotetramine chromium bromide, $ClCr(NH_3)_4(OH_2)Br_2$.

Very easily sol. in H_2O. (Cleve, **1861**; Jörgensen, J. pr. (2) **42**. 210.)

—— **chloride,** $ClCr(NH_3)_4(OH_2)Cl_2$.

Sol. in H_2O, but decomp. by boiling. Sol. in $HCl+Aq$, and this solution may be boiled without decomp. (Cleve.)

Sol. in 15·7 pts. H_2O at 15°. (Jörgensen, J. pr. **42**. 208.)

—— **chromate,** $ClCr(NH_3)_4(OH_2)CrO_4$.

Precipitate. (Cleve.)

—— **fluosilicate,** $ClCr(NH_3)_4(OH_2)SiF_6$.

Sl. sol. in H_2O. (Jörgensen, J. pr. (2) **42**. 218.)

—— **hydroxide,** $ClCr(NH_3)_4(OH)_2$.

Known only in solution. (Cleve.)

—— **iodide,** $ClCr(NH_3)_4(OH_2)I_2$.

Easily sol. in H_2O. (Cleve.)

—— **nitrate,** $ClCr(NH_3)_4(OH_2)(NO_3)_2$.

Very easily sol. in H_2O. (Cleve; Jörgensen, J. pr. (2) **42**. 209.)

—— **sulphate,** $ClCr(NH_3)_4(OH_2)SO_4$.

Very difficultly sol. in cold, more easily in hot H_2O. (Cleve.)

Chlorotetramine cobaltic bromide, $ClCo(NH_3)_4(OH_2)Br_2$.

More sol. in H_2O than chloride. Nearly insol. in $HBr+Aq$ (1 : 1). (Jörgensen, J. pr. (2) **42**. 215.)

—— **chloride,** $ClCo(NH_3)_4(OH_2)Cl_2$.

Sol. in about 40 pts. H_2O, and = octamine cobaltic purpureochloride of Vortmann. (Jörgensen, J. pr. (2) **42**. 211.)

—— **chloroplatinate,** $ClCo(NH_3)_4(OH_2)PtCl_6 + 2H_2O$.

Sl. sol. in H_2O. (Jörgensen.)

—— **chromate,** $ClCo(NH_3)_4(OH_2)CrO_4$.

Easily sol. in cold H_2O. (Jörgensen, J. pr. (2) **42**. 216.)

—— **fluosilicate,** $ClCo(NH_3)_4(OH_2)SiF_6$.

Sl. sol. in H_2O. Nearly insol. in H_2SiF_6+Aq. (Jörgensen, J. pr. (2) **42**. 219.)

—— **sulphate,** $ClCo(NH_3)_4(OH_2)SO_4$.

Sol. in H_2O. (Jörgensen, J. pr. (2) **42**. 214.)

Chlorous acid, $HClO_2$.

Known only in aqueous solution. 100 g. H_2O at 8·5° and 753 mm. pressure dissolve 4·7 g. Cl_2O_3. Hydrate with 50·07-67·43 % H_2O, perhaps $HClO_2 + H_2O$, separates out at 0°. (Brandan, A. **151**. 340.)

Pure $HClO_2$ is not known even in solution. (Garzarolli-Thurnlakh, A. **209**. 184.)

Chlorites.

All chlorites are easily sol. in H_2O and alcohol, with gradual decomp.

Ammonium chlorite.

Known only in aqueous solution, which decomposes on evaporation or long standing.

Barium chlorite, $Ba(ClO_2)_2$.

Deliquescent; easily sol. in H_2O. Solution decomp. on evaporation. Easily sol. in alcohol. (Millon, A. ch. (3) **7**. 298.)

Lead chlorite, $Pb(ClO_2)_2$.

Nearly insol. in cold H_2O, and only sl. sol. in hot H_2O. Sol. in $KOH+Aq$. (Garzarolli and Hayn, A. **209**. 203.)

Lead chlorite chloride, $6Pb(ClO_2)_2, 4PbCl_2, PbO$.

Rather difficultly sol. in H_2O. (Schiel, A. **109**. 317.)

Potassium chlorite, $KClO_2$.

Very deliquescent and sol. in H_2O. Sol. in alcohol of 38°. (Millon, A. ch. (3) **7**. 323.) Sol. in $HClO_2+Aq$.

Silver chlorite, $AgClO_2$.

Sol. in hot, less in cold H_2O. Easily decomp. by heating above 100°. Decomp. by weakest acids. (Millon, A. ch. (3) **7**. 329.)

Sodium chlorite, $NaClO_2$.

Very deliquescent, and sol. in H_2O.

Strontium chlorite, $Sr(ClO_2)_2$.

Deliquescent and sol. in H_2O. Decomp. by slow evaporation. (Millon, A. ch. (3) **7**. 327.)

Chloroxyfulminoplatinum, $Pt_4N_4Cl(OH)O_{12}H_{22}$.

Insol. in H_2O; sol. in $HCl+Aq$. (v. Meyer, J. pr. (2) **18**. 305.)

Chromacichloride, CrO_2Cl_2.

See **Chromyl chloride.**

Chromatoiodic acid.

See **Chromoiodic acid.**

Chromic acid, H_2CrO_4.

Very sol. in H_2O. (Moissan, C. R. **98**. 1581.)

Does not exist except in solution. (Field, Chem. Soc. **61**. 405.)

See also **Chromium *tri*oxide.**

Chromates.

Chromates of the alkali metals and of Ca, Mg, and Sr are sol. in H_2O; the others are generally insol. or sl. sol. in H_2O, but sol. in HNO_3+Aq.

Aluminum chromate, basic, $Al_2O_3, CrO_3 + 7H_2O$.

Easily sol. in NH_4OH+Aq, alum, or acetic acid$+Aq$. Insol. in NH_4Cl+Aq. (Farrie, Chem. Soc. **4**. 300.)

Insol. as such in H_2O, but easily decomp.

into H_2CrO_4 and a basic insol. comp. Sol. in alkaline solutions and acids. Decomp. by many salts. (Eliot and Storer, Proc. Am. Acad. **5**. 214.)

Ammonium chromate, basic, $5(NH_4)_2O, 4CrO_3$ (?).

Easily sol. in cold H_2O. (Pohl, W. A. B. **6**. 592.)

Ammonium chromate, $(NH_4)_2CrO_4$.

Very sol. in H_2O; pptd. from aqueous solution by alcohol. (Malaguti and Sarzeau.)

Ammonium *di*chromate, $(NH_4)_2Cr_2O_7$.

Less sol. in H_2O than $(NH_4)_2CrO_4$. (Moser.)

Ammonium *tri*chromate, $(NH_4)_2Cr_3O_{10}$.

Not deliquescent, but very sol. in H_2O. (Siewert.)

Decomp. by H_2O into chromic acid and dichromate. (Jäger and Krüss, B. **22**. 2036.)

Ammonium *tetra*chromate, $(NH_4)_2Cr_4O_{13}$.

Deliquescent. Decomp. by H_2O. (Jäger and Krüss, B. **22**. 2037.)

Ammonium *hexa*chromate, $(NH_4)_2Cr_6O_{19} + 10H_2O$ (?).

Very efflorescent. (Rammelsberg, Pogg. **94**. 516.)

Ammonium chromous chromate (?), $(NH_4)_2CrO_4, CrCrO_4 = (NH_4)_2Cr(CrO_4)_2$.

Difficultly sol. in H_2O. Insol. in alcohol, ether, chloroform, or glacial acetic acid. Easily sol. in conc. acids, from which it is separated on dilution. Decomp. by NaOH + Aq. (Heintze, J. pr. (2) **4**. 220.)

Ammonium ferric chromate, $(NH_4)_2CrO_4, Fe_2(CrO_4)_3 + 4H_2O$.

More easily decomp. by H_2O than $K_2CrO_4, Fe_2(CrO_4)_3 + 4H_2O$. (Hensgen, B. **12**. 1300.)

Ammonium lithium chromate, $NH_4LiCrO_4 + 2H_2O$.

Not deliquescent. (Rammelsberg.)

Ammonium magnesium chromate, $(NH_4)_2CrO_4, MgCrO_4 + 6H_2O$.

Much more sol. in H_2O than the corresponding sulphate. (v. Hauer.)

Ammonium manganous chromate, $(NH_4)_2CrO_4, 2MnCrO_4$.

Sol. in H_2O. (Hensgen, R. t. c. **3**. 433.)

Ammonium potassium chromate, NH_4KCrO_4.

Sol. in H_2O. (E. Kopp, C. N. **11**. 16.)

$+ H_2O$. (Étard, C. R. **85**. 443.)

Ammonium uranyl chromate, $(NH_4)_2CrO_4, 2(UO_2)CrO_4 + 6H_2O$.

Decomp. by boiling with H_2O. Sol. in acidulated H_2O. (Formánek, A. **257**. 106.)

$+ 3H_2O$. (Formánek.)

Ammonium chromate chromyl fluoride, $(NH_4)_2CrO_4, CrO_2F_2$.

Sol. in H_2O. (Varenne, C. R. **91**. 989.)

Ammonium chromate iodate.

See **Chromoiodate, ammonium.**

Ammonium *di*chromate mercuric chloride, $(NH_4)_2Cr_2O_7, HgCl_2$.

Cannot be recryst. from H_2O or $HgCl_2$ + Aq, but from $(NH_4)_2Cr_2O_7$ + Aq. (Jäger and Krüss, B. **22**. 2044.)

$+ H_2O$. (Richmond and Abel, Chem. Soc. Q. J. **3**. 199.)

Cannot be made to crystallise with H_2O. (Jäger and Krüss.)

$3(NH_4)_2Cr_2O_7, HgCl_2$. Decomp. by H_2O. (J. and K.)

$4(NH_4)_2Cr_2O_7, HgCl_2$. Decomp. by H_2O. (J. and K.)

$(NH_4)_2Cr_2O_7, 3HgCl_2$. (J. and K.)

$(NH_4)_3Cr_2O_7, 4HgCl_2$. (J. and K.)

Barium chromate, $BaCrO_4$.

Extremely sl. sol. in H_2O.

Calculated from electrical conductivity of $BaCrO_4$ + Aq, 1 l. H_2O dissolves 3·8 mg. $BaCrO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

When not ignited, $BaCrO_4$ is sol. in 86,957 pts. H_2O; 22,988 pts. NH_4Cl + Aq (0·5 % NH_4Cl); 3670 pts. $HC_2H_3O_2$ + Aq (5 % $HC_2H_3O_2$); 1986 pts. $HC_2H_3O_2$ + Aq (10 % $HC_2H_3O_2$); 1813 pts. H_2CrO_4 + Aq (10 % CrO_3). When ignited, 160,000 pts. H_2O are necessary for solution. (Schweitzer, by Fresenius, Z. anal. **29**. 414.)

Sol. in 23,000 pts. boiling H_2O. (Mescherzerski, Z. anal. **21**. 399.)

Insol. in $K_2Cr_2O_7$ + Aq. (Schweitzer.)

Sol. in 49,381 pts. $NH_4C_2H_3O_2$ + Aq (0·75 % salt) at 15°; in 23,355 pts. $NH_4C_2H_3O_2$ + Aq (1·5 % salt) at 15°; in 45,162 pts. NH_4NO_3 + Aq (0·5 % salt) at 15°. (Fresenius, Z. anal. **29**. 418.)

Easily sol. in HNO_3, HCl, or chromic acid + Aq, from which it is precipitated by NH_4OH, or by dilution with H_2O. (Bahr.)

Easily sol. in alkali tartrates, or citrates + Aq. (Fleischer, J. pr. (2) **5**. 326.)

Barium *di*chromate, $BaCr_2O_7 + 2H_2O$.

Decomp. by H_2O with separation of $BaCrO_4$. Sol. in H_3CrO_4 + Aq. (Bahr, J. B. **1853**. 358.)

Barium potassium *tri*chromate, $Ba_2K_2(Cr_3O_{10})_3 + 3H_2O$.

Extremely deliquescent. (Bahr.)

Bismuth chromates, basic.

These comps. are insol. in H_2O even in presence of H_2CrO_4; sol. in HCl or HNO_3 + Aq. (Löwe, J. pr. **67**. 288.)

100 pts. H_2O dissolve 0·00008 pt. "bismuth chromate"; 100 pts. acetic acid dissolve 0·00021 pt. "bismuth chromate"; 100 pts. HNO_3 + Aq (sp. gr. = 1·038) dissolve 0·00024 pt. "bismuth chromate"; 100 pts. KOH + Aq (sp. gr. = 1·33) dissolve 0·00016 pt. "bismuth chromate." (Pearson, Phil. Mag. (4) **11**. 206.)

Not insol. in dil. HNO_3 + Aq unless K_2CrO_4 is present. Less sol. in hot NaOH + Aq than $PbCrO_4$. (Storer.)

$3Bi_2O_3, 2CrO_3 = 2(BiO)_2CrO_4, Bi_2O_3$. Insol. in H_2O; sol. in HNO_3 + Aq.

Bi_2O_3, $CrO_3=(BiO)_2CrO_4$. Insol. in H_2O; easily sol. in dil. $HCl+Aq$, less in dil. HNO_3 or H_2SO_4+Aq. (Muir.)

Bi_2O_3, $2CrO_3=(BiO)_2Cr_2O_7$. Insol. in H_2O.

$+H_2O$.

$5Bi_2O_3$, $11CrO_3+6H_2O$. (Muir, Chem. Soc. **31**. 24.)

$3Bi_2O_3$, $7CrO_3$. Insol. in H_2O; easily sol. in mineral acids, especially $HCl+Aq$. Partly sol. in $KOH+Aq$.

Bismuth chromate, acid, Bi_2O_3, $4CrO_3+H_2O$.

Insol. in hot or cold H_2O. Sol. in dil. HCl or HNO_3+Aq. (Muir, Chem. Soc. **30**. 17.)

Bismuth potassium chromate, $Bi_2(CrO_4)_3$, K_2CrO_4.

Insol. in H_2O. Decomp. with hot H_2O.

Bi_2O_3, K_2O, $6CrO_3+H_2O$. (Preis and Raymann, J. B. **1880**. 336.)

Bromomolybdenum chromate.

(Atterberg).

Cadmium chromate, basic, $2CdO$, CrO_3+H_2O.

Very sl. sol. in H_2O; very slowly sol. in NH_4OH+Aq with combination. (Malaguti and Sarzeau, A. ch. (3) **9**. 431.)

Composition as above. (Freese, B. **2**. 478.)

Cadmium chromate ammonia, $CdCrO_4$, $4NH_3+3H_2O$.

Efflorescent. Decomp, by H_2O. Sol. in NH_4OH+Aq; insol. in alcohol and ether. (Malaguti and Sarzeau.)

Cadmium potassium chromate, $3CdO$, K_2O, $3CrO_3+3H_2O$.

Ppt. (Preis and Raymann, Sitzungsb. böhms. Gesell. **1880**.)

Calcium chromate, $CaCrO_4$.

Anhydrous. Very sl. sol. in H_2O. (Siewert, J. B. **1862**. 148.)

$+2H_2O$. Sol. in 241·3 pts. H_2O at 14°. (Siewert.)

Sol. in 34 pts. H_2O. (Schwarz, Dingl. **198**. 159.)

Easily sol. in H_2O containing CrO_3.

Insol. in absolute alcohol.

50 cc. of alcohol (29 %) dissolve 0·608 g. $CaCrO_4$; 50 cc. of alcohol (53 %) dissolve 0·44 g. $CaCrO_4$. (Fresenius, Z. anal. **30**. 672.)

Calcium *di*chromate, $CaCr_2O_7+3H_2O$.

Very deliquescent. (Bahr, J. pr. **60**. 60.)

Calcium potassium chromate, $CaCrO_4$, K_2CrO_4.

$+H_2O$. Easily sol. in H_2O. (Duncan.) Insol. in H_2O when ignited.

$+2H_2O$. Easily sol. in H_2O, even after ignition. Insol. in alcohol. (Duncan, J. B. **1850**. 313.)

$4CaCrO_4$, K_2CrO_4.

$5CaCrO_4$, K_2CrO_4. Sol. in much H_2O. (Bahr.)

Calcium potassium chromate sulphate, $CaCrO_4$, $K_2SO_4+H_2O$.

Decomp. by H_2O. (Hannay, Chem. Soc. **32**. 399.)

$CaCrO_4$, K_2SO_4, K_2CrO_4. As above. (H.)

Cerous chromate, $CeCrO_4$.

Insol. in H_2O.

Cerous *di*chromate.

Easily sol. in H_2O.

Chromic chromate, $CrO_2=Cr_2O_3$, CrO_3.

Insol. as such in H_2O, but decomp. thereby into CrO_3 and Cr_2O_3; decomp. by alkaline and many saline solutions. Easily sol. in dil. acids if recently pptd, but with difficulty if dried at a high temp. (Eliot and Storer, Proc. Am. Acad. **5**. 207.)

$Cr_5O_{12}=Cr_2O_3$, $3CrO_3$. Sol. in $HCl+Aq$. Very slowly sol. in HNO_3+Aq. Slowly decomp. by H_2SO_4 or NH_4OH+Aq. Easily decomp. by $KOH+Aq$.

Does not exist. (Eliot and Storer, *l.c.*)

$Cr_8O_{15}=3Cr_2O_3$, $2CrO_3$. Easily sol. in HCl or HNO_3+Aq, difficultly sol. in acetic acid. Easily sol. in $KOH+Aq$. (Traube, A. **66**. 108.)

Existence doubtful.

$Cr_5O_9=2Cr_2O_3$, CrO_3. Insol. in all acids, even aqua regia; slowly attacked by a boiling conc. solution of alkali hydroxides. (Geuther and Merz, A. **118**. 62.) Cr_3O_5, according to Wöhler.

Chromic potassium chromate, $Cr_2H_2(CrO_4)_2$, K_2CrO_4 (?).

Insol. in H_2O, alcohol, or acetic acid. Not attacked by cold HNO_3+Aq; sl. oxidised when hot. Insol. in cold, easily sol. in hot H_2SO_4. Sl. sol. in SO_2+Aq. Sol. in conc. $HCl+Aq$. (Tommasi, Bull. Soc. (2) **17**. 396.)

Chromous potassium chromate, $K_2CrO_4(CrO_2)_2$ $=K_2Cr(CrO_4)_2$ (?).

Sat. cold solution in H_2O contains 9 % of the salt. Insol. in alcohol and ether. (Heintze, J. pr. (2) **4**. 212.)

Cobaltous chromate, basic, $3CoO$, CrO_3+4H_2O.

Ppt. Decomp. by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9**. 431.)

True formula is $2CoO$, CrO_3+2H_2O. (Freese, Pogg. **140**. 252.)

Cupric chromate, basic, $3CuO$, CrO_3+2H_2O.

Insol. in H_2O. Easily sol. in dil. HNO_3+Aq and in NH_4OH+Aq. Decomp. by $KOH+Aq$. (Malaguti and Sarzeau, A. ch. (3) **9**. 434.)

$7CuO$, $2CrO_3+5H_2O$. Ppt. (Rosenfeld, B. **13**. 1469.)

$7CuO$, CrO_3+5H_2O. Ppt. (R.)

Cupric *di*chromate, basic, $CuCr_2O_7$, $2CuO$.

(Stanley, C. N. **54**. 194.)

Cupric *di*chromate, $CuCr_2O_7+2H_2O$.

Deliquescent. Very easily sol. in H_2O, NH_4OH+Aq, and alcohol. (Dröge, A. **101**, 39.)

Aqueous solution is decomp. by boiling. (Malaguti and Sarzeau, A. ch. (3) **9**. 456.)

Cupric lead chromate, $2(PbCrO_4, PbO)$, $(2CuCrO_4, CuO)$.

Min. *Vauquelinite*. Sol. in acids.

Cupric potassium chromate, K_2O, $3CuO$, $3CrO_3+2H_2O$.

Nearly insol. in H_2O. Sol. in NH_4OH or $(NH_4)_2CO_3+Aq$. (Knop, A. **70.** 52.)

Does not exist. (Rosenfeld, B. **13.** 1472.)

K_2O, $4CuO$, $4CrO_3+H_2O$. Decomp. by boiling H_2O. (Gerhardt.)

Cupric chromate ammonia, $3CuO$, $2CrO_3$, $10NH_3+2H_2O$.

Decomp. by H_2O; sl. sol. or insol. in alcohol, ether, or NH_4OH+Aq. (Malaguti and Sarzeau.)

Decomp. by hot H_2O; insol. in alcohol. (Böttger.)

Didymium chromate, $Di_2(CrO_4)_3$.

Sl. sol. in H_2O, easily in dil. acids. (Frerichs and Smith, A. **191.** 358.)

$+7H_2O$. (Cleve.)

Didymium potassium chromate, $Di_2(CrO_4)_3$, K_2CrO_4.

Precipitate. Decomp. by H_2O. (Cleve.)

Glucinum chromate, basic, $GlCrO_4$, $13GlO+23H_2O$.

Ppt. Insol. in H_2O. (Creuzburg, Dingl. **163.** 449.)

Indium chromate.

Ppt. (Meyer.)

Indium *di*chromate.

Very sol. in H_2O. Known only in solution.

Ferric chromate, basic.

Decomp. by H_2O. (Maus.)

Fe_2O_3, CrO_3. Insol. in H_2O, but decomp. thereby, or by saline solutions; easily sol. in acids. Sol. in H_2CrO_4+Aq. (Eliot and Storer, Proc. Am. Acad. **5.** 236.)

Ferric *di*chromate.

Sol. in H_2O and alcohol. (Maus, Pogg. **9.** 132.)

Ferric potassium chromate, $Fe_2(CrO_4)_3$, $K_2CrO_4+4H_2O$.

Decomp. by much H_2O, conc. HCl, or NH_4OH+Aq. Not decomp. by alcohol. (Hensgen, B. **12.** 1300.)

Lanthanum chromate, $La_2(CrO_4)_3$.

Sl. sol. in cold, more easily in hot H_2O; easily sol. in acids. (Frerichs and Smith, A. **191.** 355.)

$+8H_2O$. Ppt. (Cleve.)

Lanthanum potassium chromate.

(Cleve.)

Lead chromate, basic, $2PbO$, CrO_3 (*chrome red*).

Insol. in H_2O; acetic acid dissolves out ½ the PbO. Sol. in $KOH+Aq$. (Badams, Pogg. **3.** 221.)

$3PbO$, CrO_3. (Hermann, Pogg. **28.** 162.)

Min. *Melanochroite*, *Phoenicochroite*. Sol. in acids.

Lead chromate, $PbCrO_4$.

Insol. in H_2O. Pptd. from $Pb(NO_3)_2$ in presence of 70,000 pts. H_2O. (Harting.) Calculated from electrical conductivity of $PbCrO_4+Aq$, 1 l. H_2O dissolves 0·2 mg. $PbCrO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Sol. in dil. H_2SO_4+Aq (Storer); sl. sol. in dil. HNO_3+Aq.

Sol. in 560 pts. HNO_3+Aq of 1·12 sp. gr.; in 150 pts. HNO_3+Aq of 1·225 sp. gr.; in 130 pts. HNO_3+Aq of 1·265 sp. gr.; in 80 pts. HNO_3+Aq of 1·395 sp. gr. (Storer's Dict.)

Easily decomp. by hot $HCl+Aq$. (Fresenius.)

Insol. in $HC_2H_3O_2+Aq$.

Easily sol. in KOH, or $NaOH+Aq$. 1 l. $KOH+Aq$ (½ normal) dissolves 11·9 g. $PbCrO_4$ at 15°; 16·2 g. at 60°; 26·1 g. at 80°; 39·5 g. at 102°. (Lachaud and Lepierre, Bull. Soc. (3) **6.** 230.)

Insol. in NH_4Cl+Aq. (Brett, **1837.**)

Sol. in $K_2Cr_2O_7+Aq$; almost completely insol. in $NH_4C_2H_3O_2$, or NH_4NO_3+Aq.

Not pptd. in presence of Na citrate. (Spiller.)

Min. *Crocoite*. Sol. in hot $HCl+Aq$; difficultly sol. in HNO_3+Aq; sol. in $KOH+Aq$.

Lead *di*chromate, $PbCr_2O_7$.

Decomp. by H_2O.

$+2H_2O$. As above. (Preis and Raymann, B. **13.** 340.)

Lead lithium chromate, $PbCrO_4$, Li_2CrO_4.

(Lachaud and Lepierre, C. R. **110.** 1035.)

Lead potassium chromate, $PbCrO_4$, K_2CrO_4.

Insol. in hot or cold H_2O or in alcohol. Dil. acids dissolve out K_2CrO_4. (Lachaud and Lepierre, C. R. **110.** 1035.)

$PbCrO_4$, $2PbO$, K_2CrO_4. As above. (L. and L.)

Lead sodium chromate, $PbCrO_4$, Na_2CrO_4.

Sol. in H_2O (?). (Lachaud and Lepierre.)

$PbCrO_4$, $2PbO$, Na_2CrO_4. (L. and L.)

Lithium chromate, $Li_2CrO_4+2H_2O$.

Very easily sol. in H_2O. (Rammelsberg, Pogg. **128.** 323.)

Lithium *di*chromate, $Li_2Cr_2O_7+2H_2O$.

Deliquescent. Sol. in H_2O. (Rammelsberg.)

Magnesium chromate, $MgCrO_4+7H_2O$.

Easily sol. in H_2O. (Vauquelin.)

$+5H_2O$. Very sol. in H_2O. (Wyrouboff, Bull. Soc. Min. **12.** 69.)

Magnesium potassium chromate, $MgCrO_4$, $K_2CrO_4+2H_2O$.

100 pts. H_2O dissolve 28·2 pts. at 20°; 34·2 pts. at 60°. (Schweitzer.)

Insol. in alcohol.

Magnesium sodium chromate.

(Stanley, C. N. **54.** 194.)

Manganous chromate, $2MnO$, CrO_3+H_2O.

Ppt. Sol. in dil. H_2SO_4, or HNO_3+Aq. (Warington and Reinsch, Schw. J. **3.** 272.)

Manganous potassium chromate, $2MnCrO_4$, $K_2CrO_4+4H_2O$.

Sol. in H_2O. (Hensgen, R. t. c. **3.** 433.)

Mercurous chromate, basic, $4Hg_2O$, $3CrO_3$.

Very sl. sol. in cold, more in boiling H_2O. Sl. sol. in HNO_3+Aq. Decomp. by $HCl+Aq$. Sl. sol. in NH_4Cl+Aq or NH_4NO_3+Aq. (Brett.)

Does not exist. (Richter, B. **15.** 1489.)

$3Hg_2O$, CrO_3. Sol. in HNO_3+Aq. (Richter.)

Mercurous chromate, Hg_2CrO_4.

Very sl. sol. in cold, more readily in hot H_2O. Sl. sol. in dil. HNO_3+Aq; sol. in conc. HNO_3; sol. in $KCN+Aq$; insol. in $Hg_2(NO_3)_2+Aq$. (Rose, Pogg. **53.** 124.)

Mercuric chromate, basic, $2HgO$, CrO_3.

Sol. in HCl, and in HNO_3+Aq. (Geuther.)

$3HgO$, CrO_3. Sl. sol. in H_2O. (Millon.)

$4HgO$, CrO_3. Sl. sol. in H_2O. (Millon, A. ch. (3) **18.** 365.)

$7HgO$, $2CrO_3$. Easily sol. in warm HNO_3, when freshly precipitated. Easily sol. in $HCl+Aq$. (Geuther, A. **106.** 247.)

Does not exist. (Freese, B. **2.** 477.)

$5HgO$, CrO_3. Easily sol. in $HCl+Aq$. Very sl. sol. in HNO_3+Aq. Decomp. by H_2O into—

$6HgO$, CrO_3. Insol. in H_2O. (Jäger and Krüss, B. **22.** 2049.)

Mercuric chromate, $HgCrO_4$.

Decomp. by H_2O and acids into basic salt. (Geuther.)

Sol. in acids. Sol. in warm NH_4Cl, or NH_4NO_3+Aq. Sol. in $Hg(NO_3)_2$, or $HgCl_2+Aq$.

Mercuric chromate sulphide, $2HgCrO_4$, HgS.

Not attacked by weak acids. (Palm, C. C. **1863.** 121.)

Nickel chromate, basic, $4NiO$, CrO_3+6H_2O.

Insol. in H_2O; easily sol. in NH_4OH+Aq. (Malaguti and Sarzeau, A. ch. (3) **9.** 451.)

$3NiO$, CrO_3+6H_2O. Insol. in H_2O; sol. in NH_4OH+Aq. (Freese, J. B. **1869.** 271.)

$2NiO$, CrO_3+6H_2O. As above. (Schmidt, A. **156.** 19.)

$5NiO, 2CrO_3+12H_2O$. As above. (Schmidt.)

Nickel chromate ammonia, $NiCrO_4$, $6NH_3+4H_2O$.

Decomp. by H_2O. Quite easily sol. in NH_4OH+Aq of 0·96 sp. gr. (Schmidt.) Insol. in alcohol or ether.

Potassium chromate, K_2CrO_4.

Easily sol. in H_2O.

1 pt. dissolves in 2·07 pts. H_2O at 15·5°. (Thomson.)

1 pt. dissolves in 1·75 pts. H_2O at 17·5°, and in 1·67 pts. H_2O at 100°. (Moser.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°	40°	50°	
58·90	60·92	62·94	64·96	66·98	69·00	pts. K_2CrO_4,

60°	70°	80°	90°	100°	
71·02	73·04	75·06	77·08	79·10	pts. K_2CrO_4.

(Alluard, C. R. **59.** 500.)

100 pts. H_2O dissolve at—

0°	10°	27·37°	42·1°	
61·5	62·1	66·3	70·3	pts. K_2CrO_4,

63·6°	93·6°	106·1°	
74·9	79·7	81·8	pts. K_2CrO_4.

(Nordenskjöld and Lindström, Pogg. **136.** 314.)

100 pts. K_2CrO_4+Aq sat. at 10-12° contain 37·14 pts. salt. (v. Hauer, J. pr. **103.** 114.)

100 pts. H_2O at 19·5° dissolve 62·3 pts. K_2CrO_4, and solution has sp. gr. of 1·3787. (Schiff, A. **109.** 326.)

Sol. in 2 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O at 15° dissolve 43·857 pts. K_2CrO_4, and solution has sp. gr. of 1·3032. (Michel and Krafft, A. ch. (3) **41.** 478.)

Sp. gr. of K_2CrO_4+Aq at 19·5°.

% K_2CrO_4	Sp. gr.	% K_2CrO_4	Sp. gr.	% K_2CrO_4	Sp. gr.
1	1·0080	15	1·1287	28	1·2592
2	1·0161	16	1·1380	29	1·2700
3	1·0243	17	1·1474	30	1·2808
4	1·0325	18	1·1570	31	1·2921
5	1·0408	19	1·1667	32	1·3035
6	1·0492	20	1·1765	33	1·3151
7	1·0576	21	1·1864	34	1·3268
8	1·0663	22	1·1964	35	1·3386
9	1·0750	23	1·2066	36	1·3505
10	1·0837	24	1·2169	37	1·3625
11	1·0925	25	1·2274	38	1·3746
12	1·1014	26	1·2379	39	1·3868
13	1·1104	27	1·2485	40	1·3991
14	1·1195	...	...	...	...

(Kremers, and Schiff, calculated by Gerlach, Z. anal. **8.** 288.)

K_2CrO_4 dissolved in 2 pts. H_2O has sp. gr. 1·28; 3 pts., 1·21; 4 pts., 1·18; 5 pts., 1·15; 6 pts., 1·12; 7 pts., 1·11; 8 pts., 1·10. (Moser.)

Sp. gr. of sat. solution at 8° = 1·368. (Anthon, **1837.**)

Sat. K_2CrO_4+Aq boils at 107°. (Kremers.)

Sat. K_2CrO_4+Aq boils at 104·2° under 718 mm. pressure. (Alluard.)

Freezing-point of sat. $K_2CrO_4+Aq = -12·5°$. (Rüdorff.)

By dissolving K_2CrO_4 in 2 pts. H_2O, the temp. is lowered 10°. (Moser.)

100 pts. sat. solution of K_2CrO_4 and K_2SO contain 37·14 pts. of the two salts at 10-12°. (v. Hauer, J. pr. **103.** 114.)

Potassium *di***chromate,** $K_2Cr_2O_7$.

Sol. in H_2O, with slight absorption of heat. Less sol. in H_2O than K_2CrO_4.

Sol. in 9·6 pts. H_2O at 17·2°. (Thomson.)
" 10 " " " 18·7°. (Moser.)

100 pts. H_2O at 15° dissolve 9·126 pts. $K_2Cr_2O_7$, and solution has sp. gr. = 1·0618. (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve pts. $K_2Cr_2O_7$. A = according to Alluard (C. R. **59**. 500); K = according to Kremers (Pogg. **92**. 497).

t°	A	K	t°	A	K
0	4·6	4·97	60	45·0	50·5
10	7·4	8·5	70	56·7	...
20	12·4	13·1	80	68·6	73·0
30	18·4	...	90	81·1	...
40	25·9	29·1	100	94·1	102·00
50	35·0	...	...	...	...

Solubility in H_2O at high temperatures. 100 pts. H_2O dissolve pts. $K_2Cr_2O_7$ at t°.

t°	Pts. $K_2Cr_2O_7$	t°	Pts. $K_2Cr_2O_7$
117	128·3	148	200·6
129	153·8	180	262·7

(Tilden and Shenstone, Phil. Trans. **1884**. 23.)

$K_2Cr_2O_7$+Aq sat. at 8° has sp. gr. 1·065. (Anthon, 1837.)

Sp. gr. of $K_2Cr_2O_7$ + Aq at 19·5°.

% $K_2Cr_2O_7$	Sp. gr.	% $K_2Cr_2O_7$	Sp. gr.
1	1·007	9	1·065
2	1·015	10	1·073
3	1·022	11	1·080
4	1·030	12	1·085
5	1·037	13	1·097
6	1·043	14	1·102
7	1·050	15	1·110
8	1·056	...	—

(Kremers, calculated by Gerlach, Z. anal. **8**. 288.)

Sat. $K_2Cr_2O_7$ + Aq boils at 104° (Kremers); 103·4° (Alluard).

Insol. in alcohol.

Potassium *tri***chromate,** $K_2Cr_3O_{10}$.

Easily sol. in H_2O and alcohol. (Bothe, J. pr. **46**. 184.)

Not deliquescent; decomp. by H_2O into chromic acid and $K_2Cr_2O_7$. (Jäger and Krüss, B. **22**. 2041.)

Potassium *tetra***chromate,** $K_2Cr_4O_{13}$.

Very deliquescent, and easily sol. in H_2O. (Schwarz, Dingl. **186**. 31.)

Not deliquescent. Decomp. by H_2O. (Jäger and Krüss, B. **22**. 2042.)

Potassium samarium chromate, $K_2Sm_2(CrO_4)_4$ $+6H_2O$.

Precipitate. (Cleve.)

Potassium sodium chromate, $3K_2CrO_4$, Na_2CrO_4.

Sol. in H_2O. (v. Hauer, J. pr. **83**. 356.)

Potassium thallium chromate, K_2CrO_4, Tl_2CrO_4.

(Lachaud and Lepierre, Bull. Soc. (3) **6**. 232.)

Potassium uranyl chromate, K_2CrO_4, $2(UO_2)CrO_4+6H_2O$.

Decomp. by boiling with H_2O. Sol. in acidified H_2O. (Formánek, A. **257**. 103.)

K_2CrO_4, $(UO_2)CrO_4+H_2O$, $2K_2CrO_4$, $3(UO_2)CrO_4$ $+7H_2O$, $3K_2CrO_4$, $4(UO_2)CrO_4+7H_2O$, and K_2CrO_4, $3(UO_2)CrO_4+14H_2O$.

Precipitates. (Wiesner, C. C. **1882**. 777.)

Potassium yttrium chromate, K_2CrO_4, $Y_2(CrO_4)_3$ $+xH_2O$.

Ppt. (Cleve.)

Potassium zinc chromate, K_2O, $5ZnO$, $4CrO_3$ $+6H_2O$, or K_2O, $4ZnO$, $3CrO_3+3H_2O$.

Slightly sol. in cold, decomp. by hot H_2O. (Wöhler.)

Potassium chromate iodate.

See **Chromoiodate, potassium.**

Potassium chromate magnesium sulphate, K_2CrO_4, $MgSO_4+9H_2O$.

Sol. in H_2O. (Étard, C. R. **85**. 443.)

Potassium chromate mercuric chloride, K_2CrO_4, $2HgCl_2$.

Easily sol. in H_2O. Sol. in dil. HCl + Aq. (Darby.)

Potassium *di***chromate mercuric chloride,** $K_2Cr_2O_7$, $HgCl_2$.

Ether or absolute alcohol dissolves out $HgCl_2$. (Millon, A. ch. (3) **18**. 388.)

Can be crystallised from H_2O. (Jäger and Krüss, B. **22**. 2046.)

Potassium chromate mercuric cyanide, $2K_2CrO_4$, $3Hg(CN)_2$.

Easily sol. in H_2O.

$+H_2O$. (Dexter.)

Formula is K_2CrO_4, $2Hg(CN)_2$. (Clarke and Sterne, Am. Ch. J. **3**. 352.)

Potassium *di***chromate mercuric cyanide,** $K_2Cr_2O_7$, $Hg(CN)_2+2H_2O$.

Sol. in H_2O. (Wyrouboff, J. B. **1880**. 309.)

Potassium chromate sulphate, K_2CrO_4, $6K_2SO_4$.

Easily sol. in H_2O. (Boutron-Chalard.)

Rubidium chromate, Rb_2CrO_4.

Sol. in H_2O. (Piccard, J. pr. **86**. 455.)

Rubidium *di***chromate,** $Rb_2Cr_2O_7$.

Sol. in H_2O. (Grandeau, A. ch. (3) **67**. 227.)

Silver (argentous) chromate, Ag_4CrO_4.

Sol. in dil. acids. (Wöhler and Rautenberg.)

Existence very doubtful.

Silver chromate, Ag_2CrO_4.

Absolutely insol. in H_2O. Sol. in acids, ammonia, and alkali chromates + Aq. (Warington, A. **27**. 12.)

Appreciably sol. in cold, and still more in hot H_2O. (Meineke, A. **261**. 341.)

According to electrical conductivity of Ag_2CrO_4+Aq, 1 l. H_2O dissolves 28 mg. Ag_2CrO_4 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

100 ccm. H_2O dissolve 0·064 grain Ag_2CrO_4 at 100° C.; 100 ccm. H_2O containing 50 grains

of the following salts dissolve the given amts. of Ag_2CrO_4 at 100° C.: $NaNO_3$, 0·064 grain; KNO_3, 0·192 grain; NH_4NO_3, 0·320 grain; $Mg(NO_3)_2$, 0·256 grain. (Carpenter, J. S. C. I. **5**. 286.)

Silver *di*chromate, $Ag_2Cr_2O_7$.

Sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. (Warington.)

Decomp. by boiling with H_2O into CrO_3 and Ag_2CrO_4. (Jäger and Krüss, B. **22**. 2050.)

Silver uranyl chromate, $2Ag_2CrO_4$, UO_2CrO_4.

Ppt. (Formánek, A. **257**. 110.)

Silver chromate ammonia, Ag_2CrO_4, $4NH_3$.

Decomp. by H_2O. Sol. in warm conc. NH_4OH+Aq. (Mitscherlich, Pogg. **12**. 141.)

Silver *di*chromate mercuric cyanide, $Ag_2Cr_2O_7$, $2Hg(CN)_2$.

Scarcely sol. in cold, more readily in hot H_2O. Sol. in hot HNO_3+Aq, separating on cooling. (Darby, Chem. Soc. **1**. 24.)

Sodium chromate, $Na_2CrO_4+10H_2O$.

Deliquescent. (Kopp, A. **42**. 99.) Easily sol. in H_2O. Melts in crystal H_2O at 23°. (Berthelot.)

Sl. sol. in alcohol. (Moser.)

100 pts. absolute methyl alcohol dissolve 0·345 pt. Na_2CrO_4 at 25°. (de Bruyn, Z. phys. Ch. **10**. 783.)

Sodium *di*chromate, $Na_2Cr_2O_7$.

More sol. in H_2O than Na_2CrO_4.

$+2H_2O$. Deliquescent.

100 pts. H_2O dissolve at—

0°	15°	30°	80°	100°	139°	
107·2	109·2	116·6	142·8	162·8	209·7	pts. salt.

Sp. gr. of aqueous solution containing—

1	5	10	15	20	25	% $Na_2Cr_2O_7$,
1·007	1·035	1·071	1·105	1·141	1·171	

30	35	40	45	50	% $Na_2Cr_2O_7$.
1·208	1·245	1·280	1·313	1·343	

(Stanley, C. N. **54**. 194.)

Sodium *tri*chromate, $Na_2Cr_3O_{10}$.

Deliquescent. Very sol. in H_2O. (Stanley, C. N. **54**. 194.)

Sodium uranyl chromate, Na_2CrO_4, $2(UO_2)CrO_4+10H_2O$.

Easily sol. in H_2O. (Formánek, A. **257**. 108.)

Strontium chromate, $SrCrO_4$.

Somewhat sol. in H_2O. Sol. in 840 pts. H_2O (Meschezerski, Z. anal. **21**. 399); sol. in 831·8 pts. H_2O at 15° (Fresenius, Z. anal. **29**. 419).

Easily sol. in HCl, HNO_3, or H_2CrO_4+Aq.

Sol. in 512 pts. 0·5 % NH_4Cl+Aq at 15°.

Sol. in 63·7 pts. 1 % $HC_2H_3O_2+Aq$ at 15°.

Sol. in 348·8 pts. solution containing 0·75 % $NH_4C_2H_3O_2$, 4 drops $HC_2H_3O_2$, and 6 drops $(NH_4)_2CrO_4+Aq$. (Fresenius.)

50 ccm. alcohol (29 %) dissolve 0·0066 g. $SrCrO_4$.

50 ccm. alcohol (53 %) dissolve 0·001 g. $SrCrO_4$. (Fresenius, Z. anal. **30**. 672.)

Strontium *di*chromate, $SrCr_2O_7$.

Easily sol. in H_2O.

Strontium *tri*chromate, $SrCr_3O_{10}+3H_2O$.

Very deliquescent, and sol. in H_2O. (Preis and Raymann, B. **13**. 340.)

Thallous chromate, Tl_2CrO_4.

Ppt. Insol. in cold moderately conc. $HC_2H_3O_2+Aq$, or in very dil. HNO_3+Aq, and very sl. sol. on boiling therewith. Dil. NH_4OH, and Na_2CO_3+Aq have the same action. Attacked by very dil. $HCl+Aq$. Sol. in hot conc. $HCl+Aq$. Decomp. by dil. H_2SO_4+Aq. (Carstanjen.)

1 l. $KOH+Aq$ (112 g. per l.) dissolves about 3·5 g. Tl_2CrO_4 on boiling, which separates out on cooling.

Conc. $KOH+Aq$ (31 % KOH) can dissolve 18 g. Tl_2CrO_4 per litre. (Lepierre and Lachaud, C. R. **113**. 196.)

Thallous *di*chromate, $Tl_2Cr_2O_7$.

Insol. in H_2O, etc. Has the same properties as Tl_2CrO_4.

Thallous *tri*chromate, $Tl_2Cr_3O_{10}$.

Sol. in 2814 pts. H_2O at 15°, and 438·7 pts. at 100°. (Crookes.)

Thallic chromate.

Ppt.

Thorium chromate, $Th(CrO_4)_2+8H_2O$.

Insol. in H_2O. (Chydenius, Pogg. **119**. 54.)

Stannous chromate.

Ppt. Sol. in dil. acids. (Berzelius.)

Stannic chromate.

Ppt. (Leykauf, J. pr. **19**. 127.)

Uranyl chromate, $UO_2CrO_4+11H_2O$.

Very sol. in H_2O. (Formánek, A. **257**. 108.)

Yttrium chromate.

Deliquescent. Easily sol. in H_2O. (Berlin.)

Zinc chromate, basic, $4ZnO$, CrO_3+5H_2O.

Insol. in H_2O; sol. in hot H_2CrO_4+Aq; slowly sol. in NH_4OH+Aq. (Malaguti and Sarzeau, A. ch. (3) **9**. 431.)

$2ZnO$, CrO_3+2H_2O. Ppt. Not wholly insol. in H_2O. (Prüssen and Phillipona, A. **149**. 92.)

$4ZnO$, $2CrO_3+3H_2O$. Ppt. Insol. in H_2O. Sol. in hot H_2CrO_4+Aq. (Prüssen and Phillipona.)

Zinc chromate ammonia, $ZnCrO_4$, $4NH_3+5H_2O$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol and ether. (Malaguti and Sarzeau, A. ch. (3) **9**. 431.)

$+3H_2O$. Efflorescent. Decomp. by H_2O. Easily sol. in dil. acids and NH_4OH+Aq. (Bieler, A. **151**. 223.)

$2ZnO$, $3CrO_3$, $10NH_3+10H_2O$. Ppt. (Malaguti and Sarzeau.)

Chromic sulphuric acid.

See **Sulphochromic acid.**

Chromicyanhydric acid, $H_3Cr(CN)_6$ (?).

Insol. in H_2O. (Kaiser, A. Suppl. **3**. 163.)

Ammonium chromicyanide, $(NH_4)_3Cr(CN)_6$.

Easily sol. in H_2O. (Kaiser, A. Suppl. **3.** 163.)

Cupric chromicyanide, $Cu_3[Cr(CN)_6]_2$.

Ppt. Insol. in dil. or conc. acids, except on heating. Insol. in NH_4OH, or KOH + Aq. (Kaiser.)

Lead chromicyanide, basic, $3Pb(CN)_2, 2Cr(CN)_3, Pb(OH)_2$.

Ppt. Sol. in HNO_3, $NaOH$ + Aq, or Pb salts + Aq. (Kaiser.)

Potassium chromicyanide, $K_3Cr(CN)_6$.

Very sol. in H_2O.

100 pts. cold H_2O dissolve 30·9 pts. salt.

Insol. in absolute alcohol, but somewhat sol. in dil. alcohol.

Sol. in conc. H_2SO_4 without decomp. (Kaiser, A. Suppl. **3.** 170.)

Silver chromicyanide, $Ag_3Cr(CN)_6$.

Insol. in all solvents, excepting KCN + Aq. (Kaiser.)

Chromisulphocyanhydric acid, $H_3Cr(SCN)_6$.

Known only in aqueous solution.

Ammonium chromisulphocyanide, $(NH_4)_3Cr(SCN)_6 + 4H_2O$.

Easily sol. in H_2O. (Rössler, A. **141.** 185.)

Barium chromisulphocyanide, $Ba_3[Cr(SCN)_6]_2 + 16H_2O$.

Deliquescent, and sol. in H_2O. (R.)

Lead chromisulphocyanide, $Pb_3[Cr(SCN)_6]_2, 4PbO_2H_2 + 8H_2O$.

Insol. in H_2O, but decomp. thereby into—

$Pb_3[Cr(SCN)_5]_2, 4PbO_2H_2 + 5H_2O$. Insol. in H_2O.

Potassium chromisulphocyanide, $K_6Cr(SCN)_6 + 4H_2O$.

Sol. in 0·72 pt. H_2O and 0·94 pt. alcohol.

Silver chromisulphocyanide, $Ag_6Cr(SCN)_6$.

Insol. in H_2O or conc. HNO_3 + Aq. Insol. in NH_4OH + Aq. Sol. in KCN + Aq.

Sodium chromisulphocyanide, $Na_6Cr(SCN)_6 + 7H_2O$.

Deliquescent; sol. in H_2O.

Chromium, Cr.

Two modifications—(α) Not attacked by H_2O. Easily sol. in cold HCl + Aq. Sl. sol. in dil. H_2SO_4 + Aq. (Deville.) Easily sol. in a hot mixture of 1 pt. H_2SO_4 and 20 pts. H_2O. (Regnault, A. ch. **62.** 357.) Easily sol. in warm conc. H_2SO_4. (Gmelin.) Very slowly sol. in hot HNO_3 + Aq. (Vauquelin.) Insol. in dil. or conc. HNO_3 + Aq. (Deville.) Very slowly (Richter), not at all (Berzelius) sol. in hot aqua regia. Easily sol. in HF + Aq.

(β) Insol. in all acids, even aqua regia (Fremy); probably contains Si.

Chromium ammonia compounds.

See—

Bromotetramine chromium compounds, $BrCr(NH_3)_4X_2$.

Bromopurpureochromium compounds, $BrCr(NH_3)_5X_2$.

Chlorotetramine chromium compounds, $ClCr(NH_3)_4X_2$.

Chloropurpureochromium compounds, $ClCr(NH_3)_5X_2$.

Diamine chromium sulphocyanides, $Cr(NH_3)_2(SCN)_4M$.

Erythrochromium compounds, $(HO)Cr_2(NH_3)_{10}X_2$.

Iodopurpureochromium compounds, $ICr(NH_3)_5X_2$.

Iodotetramine chromium compounds, $ICr(NH_3)_4X_2$.

Luteochromium compounds, $Cr(NH_3)_6X_3$.

Rhodochromium compounds, $(HO)Cr_2(NH_3)_{10}X_5$.

Rhodosochromium compounds, $(HO)_3Cr_2(NH_3)_6X_3$.

Roseochromium compounds, $Cr(NH_3)_5(OH_2)X_4$.

Xanthochromium compounds, $(HO_2)Cr(NH_3)_5X_2$.

Chromous bromide, $CrBr_2$.

Sol. in H_2O. Not deliquescent in dry air. (Moissan, C. R. **92.** 1051.)

Chromic bromide, $CrBr_3$.

Anhydrous. Insol. in H_2O, but dissolves at once in presence of the least trace of $CrBr_2$. (Bauck, A. **111.** 382.)

+ $6H_2O$. Deliquescent. Very sol. in H_2O. H_2O dissolves more than 2 pts. crystals at ord. temp. Very sol. in alcohol. Insol. in ether. (Recoura, C. R. **110.** 1029.)

Blue modification. Insol. in alcohol. (Recoura, C. R. **110.** 1193.)

+ $8H_2O$. Sol. in H_2O. (Varenne, C. R. **93.** 727.)

Chromic bromide ammonia.

See **Bromotetramine chromium bromide.**

Chromous chloride, $CrCl_2$.

Deliquescent. Very sol. in H_2O with evolution of much heat. (Moberg, J. pr. **29.** 175.)

+ $1\frac{1}{2}H_2O$. (Moissan, A. ch. (5) **25.** 40.)

Chromous hydrogen chloride, $3CrCl_2, 2HCl + 13H_2O$.

Decomp. by H_2O. (Recoura, C. R. **100.** 1227.)

Chromic chloride, $CrCl_3$.

Anhydrous.—Peach-blossom-coloured modification. Insol. in pure H_2O (Peligot), but by long continued boiling of the finely divided salt with H_2O, traces are dissolved with decomp. Not decomp. by boiling conc. H_2SO_4, or other acids, even aqua regia.

Easily sol. with evolution of heat in H_2O containing only $\frac{1}{40000}$ pt. $CrCl_2$ (Peligot, J. pr. **36.** 150). Also sol. in presence of traces of $SnCl_2$ (5 mg. $SnCl_2$ cause 1 g. $CrCl_3$ to dissolve), $FeCl_2$, Cu_2Cl_2, $Na_2S_2O_3$, and other reducing substances; chlorides without reducing properties have no effect (Pelouze, A. ch. (3) **14.** 251). $TiCl_3$ and SO_2 have similar solvent action (Ebelmen, A. ch. (3) **20.** 390); also Zn + dil. acids (Moberg).

Insol. in dil. alkalies + Aq; very slowly decomp. by boiling conc. alkalies or alkali carbonates + Aq. (Fellenberg, Pogg. **50.** 76.)

Violet modification. Very sol. in H_2O to form a green solution. (Moberg, J. pr. **44.** 325.)

$+4H_2O$. Sl. deliquescent. Very sol. in H_2O, alcohol, and ethyl acetate. (Godeffroy, Bull. Soc. (2) **43.** 229.)

$+6H_2O$. Deliquescent. Sol. in H_2O, but probably decomp. to $CrOCl_2$.

$+6\frac{1}{2}H_2O$. *Green modification.* 100 pts. H_2O dissolve 130 pts. salt at 15°. Sol. in alcohol. (Recoura, C. R. **102.** 518.)

Greyish-blue modification. Very sol. in H_2O. (Recoura, C. R. **102.** 548.)

$+10H_2O$. Very deliquescent; melts in crystal H_2O at 6-7°. Very sol. in H_2O, alcohol, and ethyl acetate. (Godeffroy.)

Chromic glucinum chloride, $CrCl_3, GlCl_2 + H_2O$.

Sol. in H_2O with decomp. (Neumann, A. **244.** 329.)

Chromic magnesium chloride, $CrCl_3, MgCl_2 + H_2O$.

Decomp. by H_2O. (Neumann.)

Chromic phosphoric chloride, $CrCl_3, PCl_5$.

Decomp. by H_2O. (Cronander.)

Chromic potassium chloride, $CrCl_3, KCl$.

Decomp. by H_2O.

$CrCl_3, 2KCl + H_2O$. (Neumann, A. **244.** 329.)

$CrCl_3, 3KCl$. Easily sol. in H_2O with decomp. (Fremy, A. ch. (3) **12.** 361.)

Chromic rubidium chloride, $CrCl_3, 2RbCl + H_2O$.

Decomp. by H_2O. (Neumann, A. **244.** 329.)

Chromic sodium chloride, $CrCl_3, NaCl$.

Sol. in H_2O. (Berzelius.)

$CrCl_3, 3NaCl$. Sol. in H_2O. (Berzelius.)

Chromic thallium chloride, $CrCl_3, 3TlCl$.

Sol. with decomp. in H_2O. (Neumann, A. **244.** 329.)

Chromic chloride ammonia.

See **Chlorotetramine chromium chloride.**

Chromic chloride ferric oxide.

Fe_2O_3 is easily sol. in dil., difficultly sol. in conc. $CrCl_3 + Aq$. (Béchamp, A. ch. (3) **57.** 311.)

Chromium *tri*fluoride, CrF_3.

Perfectly sol. in H_2O. (Berzelius.)

Violet modification. $CrF_3 + 9H_2O$. Very sl. sol. in H_2O. Insol. in alcohol. Sol. in HCl, and KOH + Aq. (Fabris, Gazz. ch. it. **20.** 582.)

Chromium *hexa*fluoride, CrF_6.

Decomp. by H_2O with evolution of heat. (Berzelius.)

Correct composition is CrO_2F_2. (Oliveri, Gazz. ch. it. **16.** 218.)

Chromic cobaltous fluoride, $CrF_3, CoF_2 + 7H_2O$.

Easily sol. in H_2O. (Petersen, J. pr. (2) **40.** 60.)

Chromic nickel fluoride, $CrF_3, NiF_2 + 7H_2O$.

Somewhat more sol. in H_2O than $CrF_3, CoF_2 + 7H_2O$. (Petersen, J. pr. (2) **40.** 61.)

Chromic potassium fluoride, $CrF_3, 3KF$.

Nearly insol. in H_2O. (Christensen, J. pr. (2) **35.** 161.)

$CrF_3, 2KF + H_2O$. Nearly insol. in H_2O. Sol. in conc. HCl + Aq. (Christensen.)

Chromic sodium fluoride, $CrF_3, 2NaF + H_2O$.

(Wagner, B. **19.** 896.)

Chromous hydroxide, CrO_2H_2.

Decomp. by H_2O, especially if hot. (Peligot, A. ch. (3) **12.** 539.)

Slowly sol. in cold conc. acids, even aqua regia; almost insol. in dil. acids. (Moberg, J. pr. **43.** 119.)

Chromic hydroxide, Cr_2O_3, xH_2O, probably $Cr_2O_6H_6$.

Insol. in H_2O. Easily sol. in acids. Easily sol. in cold KOH, or NaOH + Aq; much less sol. in cold NH_4OH + Aq; the presence of NH_4Cl has no influence upon solubility in NH_4OH + Aq. (Fresenius.) Insol. in NH_4OH + Aq if it has been thoroughly washed.

Insol. in KCN + Aq, but sl. sol. in KCN + HCN + Aq. (Rodgers, **1834.**)

Gradually sol. in dil. $FeCl_3$ + Aq; after three months 2 mols. $Cr_2O_6H_6$ are dissolved by 1 mol. $FeCl_3$ without pptn. of $Fe_2O_6H_6$. (Béchamp, A. ch. (3) **57.** 296.)

Also sol. in $CrCl_3$ + Aq; in four months $1\frac{1}{2}$ mols. $Cr_2O_6H_6$ are dissolved by 1 mol. $CrCl_3$. (Béchamp.)

Sol. in $Cr(NO_3)_3$ + Aq, and clear solution formed as long as 3 mols. HNO_3 are present for 8 mols. Cr_2O_3. (Ordway, Sill. Am. J. (2) **27.** 197.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in amylamine + Aq; not pptd. in presence of alkali tartrates, sugar, etc.

$Cr_2O_6H_6 + 4H_2O$. Difficultly sol. in acids.

$Cr_2O_6H_6 + H_2O$. Extremely hygroscopic.

Exists in a soluble modification, obtained by dialysis; solution can be diluted with pure H_2O, but gelatinises with traces of salts. (Graham, Roy. Soc. Trans. **1861.** 183.)

$Cr_2O_2(OH)_2$. Insol. in boiling dil. HCl + Aq.

$Cr_2O(OH)_4$ (*Guignet's green*). Scarcely sol. in boiling HCl + Aq. (Salvétat, C. R. **48.** 295.)

Guignet gave formula as $2Cr_2O_3 + 3H_2O$.

Chromochromic hydroxide, Cr_3O_4, H_2O (?).

Slightly attacked by acids. (Peligot, A. ch. (3) **12.** 539.)

Chromous iodide, CrI_2.

Easily sol. in H_2O. (Moissan, A. ch. (5) **25.** 401.)

Chromic iodide, CrI_3 (?).

Insol. in cold, sol. in hot H_2O, but no separation occurs on cooling. (Berlin.)

Chromium nitride, Cr_2N_2.

Insol. in dil. acids and alkalies, conc. HNO_3, HCl, or HF+Aq, even on heating. Slowly sol. in hot aqua regia or cold H_2SO_4. Sol. in cold solutions of alkali hypochlorites. (Ufer, A. **112**. 281.)

Chromous oxide, CrO.

Only known in form of hydroxide, which see.

Chromic oxide, Cr_2O_3.

When ignited is nearly insol. in acids, but dissolves in H_2SO_4 by long boiling. Insol. in liquid HCl. (Gore.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 1·07 g. Cr_2O_3; 1 l. solution containing 296·5 g. sugar and 24·2 g. CaO dissolves 0·56 g. Cr_2O_3; 1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·20 g. Cr_2O_3. (Bodenbender, J. B. **1865**. 600.)

See also **Chromic hydroxide.**

Chromochromic oxide, Cr_3O_4=CrO, Cr_2O_3.

Known only in form of hydroxide, which see.

Cr_4O_5, or Cr_5O_6 (?). Insol. in acids or in aqua regia. (Bunsen, Pogg. **91**. 622.)

Not obtainable. (Geuther, A. **118**. 66.)

Chromium *tri*oxide, CrO_3.

Deliquescent, and very sol. in H_2O, to form solution of H_2CrO_4 or $H_2Cr_2O_7$.

Sp. gr. of CrO_3+Aq at t°.

t°	Sp. gr.	% CrO_3
16·0	1·0606	8·25
18·0	1·0679	8·79
14·5	1·0694	8·79
19·5	1·0957	12·34
19·0	1·1569	19·33
20·9	1·20269	31·83
20·1	1·20264	31·83
12·0	1·20714	31·83
35·0	1·20940	32·59
18·6	1·21914	32·59
15·2	1·22106	32·59
9·7	1·22384	32·59
22·0	1·3441	37·77
19·2	1·3448	37·82
22·0	1·34416	37·82
...	1·7028	62·23

(Zettnow, Pogg. **143**. 474.)

Sp. gr. of CrO_3+Aq (H_2CrO_4+Aq). M=according to Mendelejeff at 15°; Z=according to Zettnow, calculated by Gerlach (Z. anal. **27**. 300).

% CrO_3	M	Z	% CrO_3	M	Z
5	1·036	1·037	35	1·324	1·312
10	1·076	1·076	40	1·383	1·373
15	1·119	1·118	45	1·445	1·440
20	1·166	1·162	50	1·510	1·512
25	1·215	1·208	55	1·579	1·587
30	1·268	1·258	60	...	1·665

Sol. in H_2SO_4; the solubility is least when the acid contains 66 % H_2SO_4 (Schrötter); 84·5 % H_2SO_4 (Bolley).

Very sol. in H_2SO_4 of 1·85 sp. gr. Sl. sol. in cold $KHSO_4$+Aq. (Fritzsche.)

Sol. in alcohol with decomp.

Sol. in anhydrous ether.

Chromium oxide, Cr_5O_9=$2Cr_2O_3$, CrO_3.

Cr_8O_{15}=$3Cr_2O_3$, $2CrO_3$.
CrO_2=Cr_2O_3, CrO_3.
Cr_5O_{12}=Cr_2O_3, $3CrO_3$.
Cr_6O_{15}=Cr_2O_3, $4CrO_3$.

See **Chromate, chromium.**

Chromium *per*oxide, Cr_2O_7 (?).

More sol. in ether than in H_2O. Ether solution is somewhat more stable than aqueous solution. (Aschoff, J. pr. **81**. 401.)

Formula is CrO_3, H_2O_2. (Moissan, C. R. **97**. 96.)

Chromic oxychloride.

From Cr_2O_3. Sol. in H_2O as long as 1 mol. $CrCl_3$ is present for 2½ mols. $Cr_2O_6H_6$. (Ordway, Sill. Am. J. (2) **27**. 197.)

Cr_2O_3, $2CrCl_3$. Sol. in H_2O. (Kletzinsky, Zeit. Ch. **1866**. 277.)

Cr_2O_3, $CrCl_3$=CrOCl. *Anhydrous.* Only partly sol. in H_2O.

+$3H_2O$. Very deliquescent, and sol. in H_2O. (Peligot.)

Cr_2O_3, $4CrCl_3+6H_2O=Cr_2OCl_4+2H_2O$. (Peligot, J. pr. **37**. 38.)

$+9H_2O=Cr_2OCl_4+3H_2O$. Sol. in H_2O (Moberg); $=Cr_2(OH)_2Cl_4+2H_2O$ (Schiff, A. **124**. 157.)

Cr_2O_3, $8CrCl_3$.

+$24H_2O$. Sol. in H_2O (Moberg); $=Cr_2(OH)Cl_5+4H_2O$. (Schiff, *l.c.*)

From CrO_3.

See **Chromyl chloride.**

Chromium oxyfluoride, CrO_2F_2.

See **Chromyl fluoride.**

Chromium phosphide, Cr_2P_2.

Insol. in acids, but a trace dissolves in aqua regia. Insol. in HF+Aq. (Berzelius.)

Chromous selenide, CrSe.

(Moissan, C. R. **90**. 817.)

Chromic selenide, Cr_2Se_3.

Insol. in H_2O. (Moissan, C. R. **90**. 817.)

Chromous sulphide, CrS.

Insol. in H_2O or K_2S+Aq. (Peligot.)

Easily sol. in acids. (Moissan, C. R. **90**. 817.)

Min. *Daubrelite.*

Chromic sulphide, Cr_2S_3.

Insol. in H_2O or alkali sulphides+Aq. Sl. attacked by HCl+Aq. (W. Müller, Pogg. **127**. 404.)

HNO_3+Aq decomposes or not according to method of manufacture. Easily decomp. by aqua regia.

Insol. in caustic alkalies+Aq.

Insol. in K_2S+Aq. (Berzelius.)

Chromochromic sulphide, $Cr_3S_4, =CrS, Cr_2S_3$.

Insol. in H_2O, HCl, or dil. H_2SO_4+Aq. Easily sol. in HNO_3+Aq. (Gröger, W. A. B. **81.** (2) 531.)

Chromocyanhydric acid, $H_4Cr(CN)_6$.

Decomp. rapidly on air. Sol. in H_2O. (Moissan, A. ch. (6) **4.** 144.)

Potassium chromocyanide, $K_4Cr(CN)_6$.

Very sol. in H_2O; 100 pts. H_2O dissolve 32·33 pts. at 20°. Much more sol. in hot H_2O. Insol. in alcohol, ether, benzene, or chloroform. (Moissan, A. ch. (6) **4.** 136.)

Above salt was $K_3Cr(CN)_6$. (Christensen.)

$K_4Cr(CN)_6+3H_2O$. (Christensen, J. pr. (2) **31.** 166.)

Chromoiodic acid, CrO_3, HIO_3+2H_2O.

Deliquescent. (Berg, C. R. **104.** 1514.)

Ammonium chromoiodate, $CrO_3, NH_4IO_3+H_2O$.

Moderately sol. in H_2O. (Berg.)

Lithium chromoiodate, $CrO_3, LiIO_3+H_2O$.

Very sol. in H_2O. (Berg.)

Magnesium chromoiodate.

Sol. in H_2O. (Berg.)

Potassium chromoiodate, CrO_3, KIO_3.

Sol. in H_2O. (Berg.)

$+H_2O=KCrIH_2O_7$. Sl. decomp. by H_2O. (Blomstrand, J. pr. (2) **40.** 331.)

Silver chromoiodate, $CrO_3, AgIO_3$.

Sl. attacked by cold, rapidly decomp. by hot H_2O. (Berg, C. R. **111.** 42.)

Sodium chromoiodate, $CrO_3, NaIO_3+H_2O$.

Very sol. in H_2O. (Berg.)

Chromosulphuric acid, $H_2Cr_2(SO_4)_4$.

Sol. in H_2O in all proportions, but solution is easily decomp. on standing or boiling. (Recoura, Bull. Soc. (3) **9.** 586.)

$H_4Cr_2(SO_4)_5$. As above.

$H_6Cr_2(SO_4)_6$. As above.

Ammonium chromosulphate, $(NH_4)_2Cr_2(SO_4)_4+5H_2O$.

Sol. in H_2O after a few minutes. (Recoura.)

Potassium chromosulphate, $K_2Cr_2(SO_4)_4+4H_2O$.

Sol. in H_2O in a few minutes. (Recoura, Bull. Soc. (3) **9.** 590.)

Sodium chromosulphate, $Na_2Cr_2(SO_4)_4+10H_2O$.

As K salt. (Recoura.)

Chromous acid, $H_2Cr_2O_4=Cr_2O_3, H_2O$.

Chromic hydroxide shows slightly acid properties, and salts corresponding to the above acid are known.

Aluminum ferrous magnesium chromite (chrome iron ore), $(Fe, Mg)O, (Cr_2, Al_2)O_3$.

Insol. in H_2O or acids, even a mixture of H_2SO_4 and HF. (Ebelmen.)

Barium chromite, $BaCr_2O_4$.

Insol. in H_2O. (Gerber, Bull. Soc. (2) **27.** 436.)

Cadmium chromite, $CdCr_2O_4$.

Not attacked by acids. (Viard, C. R. **109.** 142.)

Calcium chromite, $2CaO, Cr_2O_3$.

Insol. in H_2O, KOH, or NH_4OH+Aq; slowly decomp. by H_2CO_3, or M_2CO_3+Aq; insol. in sugar solution. (Pelouze, A. ch. (3) **33.** 9.)

$CaCr_2O_4$. Insol. in H_2O. (Gerber, Bull. Soc. (2) **27.** 436.)

Cobaltous chromite, $CoCr_2O_4$.

(Elliot, Dissert. Göttingen, **1862.**)

Cupric chromite, $CuCr_2O_4$.

Not attacked by HNO_3+Aq. (Persoz, A. ch. (3) **25.** 283.)

Glucinum chromite, $GlCr_2O_4$.

Insol. in H_2O. (Mallard, C. R. **105.** 1260.)

Ferrous chromite (chrome iron ore).

See **Chromite, aluminum ferrous magnesium.**

Ferroferric chromite, FeO, Fe_2O_3, Cr_2O_3.

Not attacked by $HCl+Aq$. (Ebelmen.)

Ferrous magnesium chromite.

Insol. in $HCl+Aq$. Scarcely attacked by H_2SO_4.

Lead chromite, $PbCr_2O_4$.

Ppt. Insol. in $KOH+Aq$. (Chancel, C. R. **43.** 927.)

Magnesium chromite, $MgO, 2Cr_2O_3$.

Insol. in H_2O. (Nichols, Sill. Am. J. (2) **47.** 16.)

$MgCr_2O_4$. Insol. in acids or alkalies, except boiling H_2SO_4. (Schweitzer, J. pr. **39.** 259.)

Could not be obtained. (Viard, Bull. Soc. (3) **5.** 934.)

$2MgO, Cr_2O_3$. Insol. in H_2O or acids. (Nichols.)

$5MgO, 4Cr_2O_3$. Insol. in acids. (Viard, C. R. **112.** 1003.)

$3MgO, 2Cr_2O_3$. As above. (V.)

Manganese chromite, $MnCr_2O_4$.

Entirely insol. in acids. (Ebelmen, A. ch. (3) **33.** 44.)

Zinc chromite, $ZnCr_2O_4$.

Insol. in acids and alkalies. (Viard, C. R. **109.** 142.)

$+xH_2O$. (Chancel, C. R. **43.** 927.)

$3ZnO, 2Cr_2O_3$. As above. (Viard, C. R. **112.** 1003.)

$6ZnO, 5Cr_2O_3$. As above. (V.)

Chromovanadic acid.

Ammonium chromovanadate, $2(NH_4)_2O, 2CrO_3, V_2O_5+7H_2O$.

Sol. in H_2O. (Ditte, C. R. **102.** 1105.)

Chromyl chloride (chlorochromic acid), CrO_2Cl_2.

Decomp. by H_2O with evolution of much heat. Sol. in glacial acetic acid without decomposition.

*Tri***chromyl chloride,** $Cr_3O_6Cl_2$.

Deliquescent. Sol. in H_2O with gradual decomposition. Sol. in conc. $HCl+Aq$. (Thorpe, Chem. Soc. (2) **8.** 31.)

Chromyl chlorides.

From Cr_2O_3.
See **Chromium oxychlorides.**

Chromyl fluoride, CrO_2F_2.

Decomp. by H_2O with evolution of heat. (Oliveri, Gazz. ch. it. **16.** 218.)

Clay.

See **Silicate, aluminum,** Al_2O_3, SiO_2+2H_2O.

Cobalt, Co.

Not attacked by H_2O.

Sol. in dil. HCl, or H_2SO_4, or HNO_3+Aq. Conc. hot H_2SO_4, and HNO_3 decomp. with evolution of SO_2 or NO gas.

Exists also in passive state. *See* **Iron.** (Nicklès, J. pr. **61.** 186.)

Sol. in conc. $KOH+Aq$ when in finely divided state. (Winkler, J. pr. **91.** 211.)

Cobalt ammonia compounds.

See—

Anhydrooxycobaltamine compounds, $[Co(NH_3)_5]_2\begin{bmatrix}Cl\\O(OH)\end{bmatrix}X_4$.

Bromotetramine cobaltic compounds, $BrCo(NH_3)_4X_2$.

Bromopurpureocobaltic compounds, $BrCo(NH_3)_5X_2$.

Carbonatotetramine cobaltic compounds, $(CO_3)Co(NH_3)_4X$.

Chlorotetramine cobaltic compounds, $ClCo(NH_3)_4X_2$.

Chloropurpureocobaltic compounds, $ClCo(NH_3)_5X_2$.

Croceocobaltic compounds, $Co(NH_3)_4(NO_2)_2X$.

Decamine cobaltic sulphite, $Co_2(NH_3)_{10}(SO_3)_3$.

Diamine cobaltic nitrites, $Co(NH_3)_2(NO_2)_4M$.

Dichrocobaltic compounds, $Co(NH_3)_3X_3$.

Flavocobaltic compounds, $(NO_2)_2Co(NH_3)_4X$.

Fuscocobaltic compounds, $(OH)Co(NH_3)_4X_2$.

Iodotetramine cobaltic compounds, $ICo(NH_3)_4X_2$.

Luteocobaltic compounds, $Co(NH_3)_6X_3$.

Melanocobaltic compounds, $[Co(NH_3)_3Cl_2]_2$, NH_2Cl.

Nitratotetramine cobaltic compounds, $(NO_3)Co(NH_3)_4X_2$.

Nitratopurpureocobaltic compounds, $(NO_3)Co(NH_3)_5X_2$.

Nitritocobaltic compounds, $(NO_2)Co(NH_3)_5X_2$.

Octamine cobaltic compounds, $Co_2(NH_3)_8X_6$. (= **Tetramine cobaltic compounds,** $Co(NH_3)_4X_3$).

Oxycobaltamine compounds, $Co_2(NH_3)_{10}OH(OOH)X_4$.

Praseocobaltic compounds, $Co(NH_3)_4X_3$.

Purpureocobaltic compounds, $Co(NH_3)_5X_3$.

Roseocobaltic compounds, $Co(NH_3)_5(OH_2)X_3$.

Sulphatotetramine cobaltic compounds, $(SO_4)Co(NH_3)_4X$.

Sulphatopurpureocobaltic compounds, $(SO_4)Co(NH_3)_5X$.

"Tetramine cobaltic" compounds, $Co(NH_3)_2X_3$.

Xanthocobaltic compounds $(NO_2)Co(NH_3)_5X_2$.

Cobalt arsenide, $CoAs_3$.

Min. *Skutterudite.* Sol. in HNO_3+Aq, with separation of As_2O_3.

Cobalt arsenide sulphide, $CoAs_2$, CoS_2.

Min. *Cobaltite.* Sol. in HNO_3+Aq, with separation of S and As_2O_3.

Glaucodote. Completely sol. in HNO_3+Aq.

Cobaltous bromide, $CoBr_2$.

Deliquescent. Sol. in H_2O, alcohol, and ether.

+2, and $6H_2O$. (Hartley, Chem. Soc. (2) **12.** 214.)

Cobalt stannic bromide.

See **Bromostannate, cobalt.**

Cobaltous bromide ammonia, $CoBr_2$, $6NH_3$.

Sol. in H_2O with residue of cobaltic hydroxide. (Rammelsberg, Pogg. **55.** 245.)

Cobaltous chloride, $CoCl_2$.

Deliquescent. Sol. in H_2O with evolution of heat. 100 pts. H_2O dissolve 43·3 pts. $CoCl_2$ at 0°. (Engel, A. ch. (6) **17.** 355.)

100 pts. sat. $CoCl_2+Aq$ at t° contain pts. $CoCl_2$.

t°	Pts. $CoCl_2$	t°	Pts. $CoCl_2$	t°	Pts. $CoCl_2$
−22	24·7	25	34·4	56	48·4
− 4	28·0	34	37·5	78	48·8
+ 7	31·2	41	39·8	94	50·5
11	31·3	45	41·7	96	51·2
12	32·5	49	46·7	112	52·3

(Étard, C. R. **113.** 699.)

$+H_2O$.

$+2H_2O$. Very deliquescent. (Bersch, J. B. **1867.** 291.)

$+4H_2O$. Deliquescent. (Bersch.)

$+6H_2O$. Not deliquescent. Easily sol. in H_2O.

Sp. gr. of $CoCl_2+Aq$ containing—

5	10	12	20	25	% $CoCl_2$.
1·0496	1·0997	1·1579	1·2245	1·3002	

Sat. solution 1·3613.

(Franz, J. pr. (2) **5.** 284.)

Sp. gr. of $CoCl_2+Aq$ containing in 1000 g. H_2O, g. $CoCl_2+6H_2O$—

119 g. (= ½ mol.)	238	357	476	594
1·055	1·101	1·141	1·177	1·209
833	952	1071	1190	
1·238	1·264	1·287	1·309	

Containing g. $CoCl_2$ (anhydrous)—

65 g. (= ½ mol.)	130	195	260	325	390
1·058	1·112	1·164	1·213	1·260	1·304

(Gerlach, Z. anal. **28.** 466.)

Solubility in $HCl+Aq$ at 0°. $\frac{CoCl_2}{2}=\frac{1}{2}$ mols.

$CoCl_2$ in mgs. in 10 ccm. of solution. HCl = mols. HCl in mgs. in ditto. H_2O = g. H_2O.

$\frac{CoCl_2}{2}$	HCl	$CoCl_2$ $+HCl$	Sp. gr.	H_2O
62·4	0	62·4	1·343	9·36
58·525	3·7	62·2	1·328	9·34
50·8	11·45	62·25	1·299	9·27
37·25	25·2	62·45	1·248	9·13
12·85	55·0	67·85	1·167	...
4·75	74·75	79·50	1·150	8·46
12·0	104·5	116·5	1·229	7·5
25·0	139·0	164·0	1·323	...

(Engel, A. ch. (6) **17.** 355.)

Sol. in alcohol.

Sat. solution in alcohol (0·792 sp. gr.) contains 23·66 % $CoCl_2$ and has sp. gr. = 1·0107. (Winkler, J. pr. **91.** 209.)

Very sol. in ether.

100 pts. acetone dissolve 8·62 pts. anhydrous $CoCl_2$. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Cobalt lithium chloride, $CoCl_2, LiCl+3H_2O$.

Very deliquescent. Sol. in H_2O with decomp. Sol. in $LiCl+Aq$ without decomp. Sol. in alcohol without decomp. (Chassevant, A. ch. (6) **30.** 27.)

Cobaltous mercuric chloride, $CoCl_2, HgCl_2$.

Very deliquescent. (v. Bonsdorff.)

Cobaltous stannic chloride, $CoCl_2, SnCl_4+6H_2O$.

See **Chlorostannate, cobaltous.**

Cobaltous chloride ammonia, $CoCl_2, 2NH_3$.

Decomp. by H_2O. (F. Rose.)

$CoCl_2, 4NH_3$. Decomp. by H_2O. (H. Rose.)

$CoCl_2, 6NH_3$. Decomp. by H_2O. Sol. in dil. NH_4OH+Aq with ease, but difficultly in conc. NH_4OH+Aq. Insol. in absolute alcohol. (Fremy.)

Cobaltous fluoride, CoF_2.

Sl. sol. in H_2O; insol. in alcohol and ether, slowly attacked by cold HCl, H_2SO_4, or HNO_3+Aq. (Poulenc, C. R. **114.** 1429.)

$+2H_2O$. Sol. in a little H_2O without decomp. Decomp. into oxyfluoride by boiling with much H_2O. Sol. in $HF+Aq$. (Berzelius.)

Cobalt columbium fluoride.

See **Fluocolumbate, cobalt.**

Cobaltous manganic fluoride, $2CoF_2, Mn_2F_6+8H_2O$.

(Christensen, J. pr. (2) **34.** 41.)

Cobalt molybdenyl fluoride.

See **Fluoxymolybdate, cobalt.**

Cobaltous potassium fluoride, CoF_2, KF.

Sl. sol. in H_2O; less in ethyl or methyl alcohol; insol. in amyl alcohol or benzene. Decomp. by hot H_2SO_4. (Poulenc, C. R. **114.** 747.)

$+H_2O$. Sl. sol. in H_2O. (Wagner, B. **19.** 896.)

$CoF_2, 2KF$.

Cobaltous sodium fluoride, $CoF_2, NaF+H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Cobalt vanadium fluoride.

See **Fluovanadate, cobalt.**

Cobaltous hydroxide, CoO_2H_2.

Insol. in H_2O. Sol. in acids. Insol. in $KOH+Aq$. Sol. in ammonium sulphate, chloride, nitrate, or succinate $+Aq$. (Brett.)

Sol. in warm acetic acid; insol. in NH_4OH+Aq and cold NH_4Cl+Aq, but sol. in warm NH_4Cl+Aq. (de Schulten, C. R. **109.** 266.)

Insol. in H_2O and dil. $KOH+Aq$; somewhat sol. in conc. $KOH+Aq$; easily sol. in NH_4 salts $+Aq$. (Fresenius.)

Easily sol. in $KCN+Aq$. (Rodgers, **1834.**)

Sol. in conc. K_2CO_3+Aq. (Gmelin.)

Not pptd. by $KOH+Aq$ in presence of $H_2C_4H_4O_6$ or NH_4 citrate. (Spiller.)

Insol. in methyl, or amyl amine $+Aq$. (Wurtz.)

Many non-volatile organic substances prevent its pptn.

Cobaltic hydroxide, $3Co_2O_3, 2H_2O$.

(Mills, Phil. Mag. (4) **35.** 257.)

$Co_2O_3, 2H_2O$. Decomp. by $HCl+Aq$; gives brown solutions with cold HNO_3 or H_2SO_4+Aq, which soon decomp. (Wernicke, Pogg. **141.** 120.)

$Co_2O_6H_6=Co_2O_3, 3H_2O$. Sol. in warm HCl, HNO_3, and H_2SO_4, with decomp. (Proust.)

Sol. in cold H_3PO_4, H_2SO_4, HNO_3, or $HCl+Aq$, but decomp. on standing or warming. (Winkelblech.)

Sol. in racemic, tartaric, oxalic, or citric acid as cobaltous salt.

Sol. in conc. acetic acid without immediate decomp. (Remelé). Solution is not decomp. by boiling. Sol. in warm sat. $(NH_4)_2C_2O_4+Aq$ with decomp.

Not attacked by cold or hot NH_4OH+Aq.

Insol. in boiling NH_4Cl+Aq.

Sol. when freshly pptd. in $(NH_4)_2SO_3+Aq$. (Geuther, A. **128.** 157.)

Cobaltocobaltic hydroxide, $Co_3O_4, 3H_2O$.

Insol. in H_2O. Sol. in oxalic acid; solution decomp. by heat. Sol. in $HCl+Aq$ with evolution of Cl. (Gibbs and Genth, Sill. Am. J. (2) **23.** 257.)

$Co_3O_4, 7H_2O$. Sol. in weak acids, especially $HC_2H_3O_2$ without decomp. (Fremy.)

$Co_5O_7, 6H_2O$. Min. *Heterogenite.* Sol. in dil. $HCl+Aq$ with evolution of Cl.

Cobaltous iodide, CoI_2.

Deliquescent, and very sol. in H_2O.

100 pts. sat. CoI_2+Aq at t° contain pts. CoI_2.

t°	Pts. CoI_2	t°	Pts. CoI_2	t°	Pts. CoI_2
−22	52·4	14	61·6	60	79·2
− 8	56·7	25	66·4	82	80·7
− 2	58·7	34	73·0	111	80·9
+ 9	61·4	46	79·0	156	83·1

(Étard, C. R. **113**. 699.)

Easily sol. in alcohol.
$+2H_2O$.
$+4H_2O$. Very deliquescent. (Étard.)
$+6H_2O$. (Hartley, Chem. Soc. (2) **12**. 214.)

Cobaltous iodide ammonia, $CoI_2, 4NH_3$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **48**. 155.)

$CoI_2, 6NH_3$. Insol. in NH_4OH+Aq. (Rammelsberg.)

Cobaltic octamine compounds.

See **Octamine cobaltic compounds.**

Cobaltous oxide, CoO.

Insol. in H_2O. Easily sol. in dil. or conc. HCl or HNO_3+Aq. Slowly sol. in cold, but easily in hot dil. H_2SO_4+Aq, acetic, or tartaric acid +Aq. Insol. in NH_4OH+Aq. Sol. in hot NH_4Cl+Aq, KOH, or NaOH+Aq. (Rose.)

Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett, **1834**.)

Insol. in K_2CO_3+Aq. Sol. in boiling Ce and Ni nitrates +Aq, with pptn. of the oxides. (Persoz.)

Easily sol. in dil. acids, even tartaric, acetic, and oxalic acids. Not attacked by NH_4OH+Aq. Sol. in 13 % NH_4Cl+Aq with evolution of NH_3; also in NH_4SCN+Aq. Sol. in warm conc. NaOH, and KOH+Aq. (Zimmerman, A. **232**. 324.)

Solubility in (calcium sucrate + sugar) + Aq. 1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 1·56 g. CoO; 1 l. solution containing 296·5 g. sugar and 24·2 g. CaO dissolves 1·00 g. CoO; 1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·29 g. CoO. (Bodenbender, J. B. **1865**. 600.)

See also **Cobaltous hydroxide.**

Cobaltic oxide, Co_2O_3.

Decomp. by most acids, even in the cold, with formation of cobaltous salts. Sol. in acetic acid without immediate decomp.

See also **Cobaltic hydroxide.**

Cobaltocobaltic oxide, $Co_3O_4 = CoO, Co_2O_3$.

Insol. in boiling conc. HCl, HNO_3, or aqua regia. Sol. by long standing with H_2SO_4. (Gibbs and Genth, Sill. Am. J. (2) **23**. 257.)

See also **Cobaltocobaltic hydroxide.**

$Co_4O_5 = 2CoO, Co_2O_3$.

$Co_6O_7 = 4CoO, Co_2O_3$. Not attacked by boiling dil. HNO_3 or H_2SO_4+Aq. (Beetz.)

$Co_8O_9 = 6CoO, Co_2O_3 + 20H_2O$. Sol. in dil. acids, with residue of Co_2O_3, which dissolves on warming. (Gentele, J. pr. **69**. 131.)

$+8H_2O$. As above. (Gentele.)

Cobaltous oxychloride, $CoCl_2, 3CoO + 3\frac{1}{2}H_2O$.

Ppt. Very sl. sol. in H_2O. (Habermann, M. **5**. 432.)

Cobaltous oxyfluoride, $CoO, CoF_2 + H_2O$.

Ppt. (Berzelius, Pogg. **1**. 26.)

Cobaltous oxyiodide, CoO, CoI_2.

Insol. in H_2O. (Rammelsberg.)

Cobaltous oxysulphide, CoO, CoS.

Cold HCl+Aq dissolves out CoO; hot HCl+Aq decomp. with evolution of H_2S. (Arfvedson, Pogg. **1**. 64.)

Cobalt phosphide, Co_3P_2.

Insol. in conc. HCl+Aq. Sol. in HNO_3+Aq. (Rose, Pogg. **24**. 332.)

Cobaltous selenide, CoSe.

(Little, A. **112**. 211.)

Cobaltous sulphide, CoS.

Anhydrous. Easily sol. in acids, even $HC_2H_3O_2$, but only slowly in the latter case. (Hjortdahl, C. R. **65**. 75.)

Not attacked by cold dil. HCl+Aq. (Ebelmen, A. ch. (3) **25**. 94.)

Min. *Seypoorite.*

$+xH_2O$. Sol. in conc. mineral acids; very sl. sol. in cold dil. acids; scarcely sol. in acetic acid. (Wackenroder.)

Sol. when still moist in SO_2+Aq. (Berthier.)

Easily sol. in HNO_3, but only very sl. sol. in HCl+Aq. Not pptd. from very dil. acid solutions by H_2S.

Insol. in H_2O, alkalies, and alkali carbonates, or sulphides +Aq. (Fresenius.)

Insol. in NH_4Cl, and NH_4NO_3+Aq. (Brett.)

Pptd. by $(NH_4)_2S$+Aq, and shows a brown colour in presence of 200,000 pts. H_2O. (Pfaff.)

Tartaric acid, etc. does not hinder the pptn. by $(NH_4)_2S$+Aq. (Rose.)

Sol. in potassium thiocarbonate + Aq. (Rosenbladt, Z. anal. **26**. 15.)

Sol. in Na_2S_x or K_2S_x+Aq. (de Koninck, Zeit. angew. Ch. **1891**. 202.)

Cobaltic sulphide, Co_2S_3.

Partially decomp. by HCl+Aq; sol. in HNO_3+Aq with decomposition.

Sl. attacked by HCl+Aq; and slowly even by aqua regia. (Schneider, J. pr. (2) **9**. 209.)

Min. *Cobalt pyrite.*

$+xH_2O$. Insol. in KCN+Aq. (Fleck, J. pr. **97**. 303.) More sol. in HCl+Aq than CoS_2. (Dingler, Berz. J. B. **10**. 139.)

Cobaltocobaltic sulphide, Co_3S_4.

Min. *Linnæite.* Sol. in warm HNO_3+Aq, with residue of S.

Cobalt *di***sulphide,** CoS_2.

Not attacked by alkalies or acids except HNO_3 and aqua regia. (Setterberg, Pogg. **7**. 40.)

Cobalt sulphide, Co_4S_3.

Easily sol. in hot HCl with evolution of H_2S (and H_2 !). (Proust.)

Cobalt telluride, $CoTe$.
(Fabre, C. R. **105.** 673.)

Cobalt decamine sulphurous acid.

See **Decamine cobaltisulphurous acid.**

Cobaltic acid.

Potassium cobaltate, $K_2Co_9O_{16}+2H_2O$, or $3H_2O$.

Insol. in H_2O (Pebal, A. **100.** 262), but decomp. by long boiling. Sol. in conc. acids.

K_2O, $xCoO_3$. Sol. in H_2O. (Winkler, J. pr. **91.** 351.)

Does not exist. (Donath, W. A. B. **102, 2b.** 71.)

Cobalticyanhydric acid, $H_3Co(CN)_6+\frac{1}{2}H_2O$.

Deliquescent. Very sol. in H_2O and only sl. decomp. on boiling.

Sol. in $HCl+Aq$ without decomp. even on boiling. Sl. sol. in conc., more sol. in dil. HNO_3+Aq. Not decomp. by boiling conc. HNO_3+Aq or aqua regia. Insol. in conc., sl. sol. in dil. H_2SO_4+Aq. Sol. in alcohol. Insol. in ether. (Zwenger, A. **162.** 157.)

Ammonium cobalticyanide, $(NH_4)_3Co(CN)_6+\frac{1}{2}H_2O$.

Very sol. in H_2O; sl. sol. in alcohol.

Ammonium barium cobalticyanide, $NH_4BaCo(CN)_6+H_2O$.

Sol. in H_2O. (Weselsky.)

Ammonium calcium cobalticyanide, $NH_4CaCo(CN)_6+10H_2O$.

Sol. in H_2O.

Ammonium lead cobalticyanide, $NH_4PbCo(CN)_6+3H_2O$.

Sol. in 8·31 pts. H_2O at 18°, and sl. sol. in 93 % alcohol. (Schuler.)

Ammonium sodium cobalticyanide, $NH_4Na_2Co(CN)_6$.

Only sl. sol. in H_2O. (Weselsky, B. **2.** 598.)

Ammonium strontium cobalticyanide, $NH_4SrCo(CN)_6+9H_2O$.

Sol. in H_2O. (W.)

Barium cobalticyanide, basic, $Ba_3[Co(CN)_6]_2$, BaO_2H_2.

Not very stable. Cannot be recryst. without partial decomp. (W.)

Barium cobalticyanide, $Ba_3[Co(CN)_6]_2+10H_2O$.

Sl. efflorescent. Very sol. in H_2O. Insol. in alcohol.

Barium cobalticyanide chloride, $Ba_3[Co(CN)_6]_2$, $BaCl_2+16H_2O$.

Sol. in H_2O without decomp. (W.)

Barium lithium cobalticyanide, $BaLiCo(CN)_6+15H_2O$.

The most. sol. of the double cobalticyanides. (Weselsky.)

Barium potassium cobalticyanide, $BaKCo(CN)_6+11H_2O$.

Sol. in H_2O. (W.)

Calcium potassium cobalticyanide, $CaKCo(CN)_6+9H_2O$.

Sol. in H_2O. (W.)

Cobaltous cobalticyanide, $Co_3[Co(CN)_6]_2+14H_2O$.

Insol. in H_2O and acids. Sl. sol. in NH_4OH+Aq. Decomp. by $KOH+Aq$.

Cupric cobalticyanide, $Cu_3[Co(CN)_6]_2+7H_2O$.

Insol. in H_2O and acids. Sol. in NH_4OH+Aq.

Cupric cobalticyanide ammonia, $Cu_3[Co(CN)_6]_2$, $4NH_3+7H_2O$.

Sol. in H_2O. (Zwenger.)

Lead cobalticyanide, basic, $Pb_3[Co(CN)_6]_2$, $3PbO_2H_2+11H_2O$.

Insol. in H_2O or alcohol; somewhat sol. in hot $Pb(CrH_3O_2)_2+Aq$. (Schuler.)

Lead cobalticyanide, $Pb_3[Co(CN)_6]_2+4H_2O$.

Very sol. in H_2O. Insol. in alcohol. (Zwenger.)

$+7H_2O$. Sol. in 1·77 pts. H_2O at 18°, and 1·63 pts. at 19°. Insol. in absolute alcohol. Sl. sol. in 93 % alcohol. (Schuler, W. A. B. **79.** 302.)

Lead potassium cobalticyanide, $PbKCo(CN)_6+3H_2O$.

Sol. in 6·74 pts. H_2O at 18° and much more easily in hot H_2O. Insol. in absolute, sl. sol. in 93 % alcohol. (Schuler.)

Lead cobalticyanide nitrate, $Pb_3[Co(CN)_6]_2$, $Pb(NO_3)_2+12H_2O$.

Sol. in 16·91 pts. H_2O at 18°, 16·79 pts. at 19°, and much less hot H_2O.

Nearly insol. in 93 % alcohol. (Schuler.)

Nickel cobalticyanide, $Ni_3[Co(CN)_6]_2+12H_2O$.

Insol. in H_2O and acids. Not attacked by boiling $HCl+Aq$. Sol. in NH_4OH+Aq. Decomp. by $KOH+Aq$.

Nickel cobalticyanide ammonia, $Ni_3[Co(CN)_6]_2$, $4NH_3+7H_2O$.

Insol. in H_2O.

Potassium cobalticyanide, $K_3Co(CN)_6$.

Easily sol. in H_2O. Insol. in alcohol.

Potassium strontium cobalticyanide, $KSrCo(CN)_6+9H_2O$.

Sol. in H_2O. (Weselsky.)

Silver cobalticyanide, $Ag_3Co(CN)_6$.

Insol. in H_2O and acids. Sol. in NH_4OH+Aq.

Silver cobalticyanide ammonia, $Ag_3Co(CN)_6$, $NH_3+\frac{1}{2}H_2O$.

Insol. in H_2O. (Zwenger.)

Sodium cobalticyanide, $Na_3Co(CN)_6+2H_2O$.

Easily sol. in H_2O; insol. in alcohol.

Strontium cobalticyanide, $Sr_3[Co(CN)_6]_2+10H_2O$.

Very sol. in H_2O. (Weselsky.)

Thallium cobalticyanide, $Tl_3Co(CN)_6$.

100 pts. H_2O dissolve 3·6 pts. at 0°, 5·86 pts. at 9·5°, 10·04 pts. at 19·5°. (Fronmüller, B. **11.** 91.)

Yttrium cobalticyanide, $YCo(CN)_6+2H_2O$.

Nearly insol. in H_2O. (Cleve.)

Cobaltisulphurous acid, $H_6Co_2(SO_3)_6$.

Not obtained in a solid state. (Berglund, Acta Lund. **1872.**)

Cobaltisulphites.

The cobaltisulphites are insol. or at least very sl. sol. in H_2O. (Berglund, Acta Lund. **1872.** 23.)

Ammonium cobaltous cobaltisulphite, $(NH_4)_2SO_3$, $2CoSO_3$, $Co_2(SO_3)_3+14H_2O=(NH_4)_2Co_2Co_2(SO_3)_8+14H_2O$.

Scarcely sol. in H_2O, but decomp. thereby. Easily sol. in acids, when finely divided; also in H_2SO_3+Aq. (Berglund.)

$2(NH_4)_2SO_3$, $CoSO_3$, $Co_2(SO_3)_3+8H_2O=(NH_4)_4CoCo_2(SO_3)_8+8H_2O$. As above. (Berglund.)

Barium cobaltisulphite, $3BaSO_3$, $Co_2(SO_3)_3+12H_2O=Ba_3Co_2(SO_3)_6+12H_2O$.

Ppt. Insol. in H_2O. Not attacked by cold acids, even H_2SO_4, but is decomp. by boiling therewith. (Berglund, Acta Lund. **1872.**)

Bismuth cobaltisulphite, $Bi_2Co_2(SO_3)_6$.

Insol. in H_2O, dil. HNO_3, or HCl+Aq. (Berglund, Acta Lund. **1872.** 31.)

Calcium cobaltisulphite, $Ca_3Co_2(SO_3)_6$.

Ppt. Insol. in H_2O or HCl+Aq. (Berglund, Acta Lund. **1872.** 30.)

Cobaltous cobaltisulphite, $Co_3Co_2(SO_3)_6=3CoSO_3$, $Co_2(SO_3)_3$.

Ppt. (Berglund, B. **7.** 470.)

Cobaltous potassium cobaltisulphite, $CoK_4Co_2(SO_3)_6$.

Insol. in H_2O. (Berglund.)

Silver cobaltisulphite, $Co_2(SO_3)_3$, $3Ag_2SO_3$.

Properties as the following comp. (Berglund.)

Silver cobaltous cobaltisulphite, $CoSO_3$, $Co_2(SO_3)_3$, $2Ag_2SO_3+9H_2O$.

Insol. in H_2O. Insol. in HNO_3+Aq. Decomp. by HCl or H_2S+Aq. (Berglund.)

Sodium cobaltous cobaltisulphite.

Decomp. by H_2O, so that it has not been obtained pure. (Berglund, Acta Lund. **1872**, 29.)

Cobaltoctamine sulphurous acid.

See **Octamine cobaltisulphurous acid.**

Cobaltocyanhydric acid, $H_4Co(CN)_6$.

Very unstable. Sol. in H_2O. Insol. in alcohol.

Potassium cobaltocyanide, $K_4Co(CN)_6$.

Decomp. on air. Very deliquescent, and sol. in H_2O. Insol. in alcohol and ether. (Descamps, Zeit. Ch. **1868.** 952.)

Cobaltous acid.

Barium cobaltite, $BaCoO_3$.

Insol. in H_2O or dil. $HC_2H_3O_2$+Aq. Sol. in HCl+Aq. (Rousseau, C. R. **109.** 64.)

$BaCo_2O_5$. As above. (Rousseau.)

Magnesium cobaltite.

Insol. in H_2O, NH_4OH, or $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4Cl+Aq, from which it is pptd. by KOH+Aq. (Berzelius, Pogg. **33.** 126.)

Sodium cobaltite.

Sol. in NaOH+Aq, but pptd. by diluting the solution.

Columbic acid (Niobic acid), $3Cb_2O_5$, $4H_2O$, or $3Cb_2O_5$, $7H_2O$.

Easily sol. in HF; very sl. sol. in HCl+Aq, but is sol. in H_2O after being treated with HCl+Aq. Sol. in conc. H_2SO_4. Sol. in KOH+Aq. Insol. in NaOH+Aq, but becomes sol. in H_2O by being treated with NaOH+Aq. Sol. in boiling Na_2CO_3+Aq. (Rose, Pogg. **113.** 109.)

Cb_2O_5, $4H_2O$.

Cb_2O_5, $7H_2O$. (Santesson, Bull. Soc. (2) **24.** 52.)

Calcium columbate, $2CaO$, Cb_2O_5.

Insol. in H_2O. (Joly, C. R. **81.** 266.)

CaO, Cb_2O_5. As above.

Ferrous columbate, $Fe(CbO_3)_2$.

Min. *Columbite.* Insol. in acids.

Ferrous columbate tantalate, $xFe(TaO_3)_2$, $yFe(CbO_3)_2$.

Min. *Tantalite.* Not attacked by acids.

$Fe(CbO_3)_2$, $4Fe(TaO_3)_2$. Min. *Tapiolite.*

Magnesium columbate, $Mg(CbO_3)_2+4H_2O$.

Precipitate. (Rammelsberg.)

$4MgO$, Cb_2O_5. Insol. in H_2O. (Joly, C. R. **81.** 266.)

$3MgO$, Cb_2O_5. As above.

Manganous columbate.

Insol. in H_2O. (Joly, C. R. **81.** 266.)

Potassium columbate, $KCbO_3$.

Sol. in H_2O. (Joly, in Fremy's Encyc. Ch.)

$K_2Cb_4O_{11}+5\frac{1}{2}H_2O$. Insol. in H_2O. (Santesson.)

$K_2Cb_6O_{16}+5H_2O$. Nearly insol. in H_2O.

$K_2Cb_4O_{11}+11H_2O$. Insol. in H_2O. (Santesson, Bull. Soc. (2) **24.** 53.)

$K_4Cb_6O_{17}+11H_2O$. (Santesson.)

$K_6Cb_4O_{13}+13H_2O$. Sol. in H_2O.

$K_8Cb_6O_{19}+16H_2O$. Efflorescent. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 20.)

$K_{14}Cb_{12}O_{37}+32H_2O$. Sol. in H_2O.

Potassium sodium columbate, $3K_2O$, Na_2O, $3Cb_2O_5+9H_2O$.

Very slightly sol. in H_2O. Insol. in alkalies. (Marignac.)

Sodium columbate, $NaCbO_3+3\frac{1}{2}H_2O$.

Completely sol. in H_2O. (Rose).

$+2\frac{1}{2}H_2O$. Sl. sol. in cold H_2O. Insol. in $NaOH+Aq$. (Santesson.)

$2Na_2O, 3Cb_2O_5+9H_2O$. Insol. in H_2O or $NaOH+Aq$. (Santesson.)

$8Na_2O, 7Cb_2O_5$. 1 pt. is sol. in 195-200 pts. H_2O at 14-20°; in either 75-80 pts. or in 103 pts. boiling water. (Rose.)

Yttrium columbate, Y_2O_3, Cb_2O_5.

Insol. in H_2O. (Joly, C. R. **81.** 1261.)

Columbium (Niobium), Cb.

Scarcely attacked by HCl, HNO_3, or aqua regia. Conc. H_2SO_4 dissolves easily on warming.

Columbium *penta***bromide,** $CbBr_5$.

(Rose, Pogg. **104.** 422.)

Columbium carbide nitride, 3CbC, 2CbN.

(Joly, Bull. Soc. (2) **25.** 506.)

Columbium *tri***chloride,** $CbCl_3$.

Not deliquescent; not attacked by H_2O, but easily oxidised by HNO_3+Aq. Insol. in NH_4OH+Aq. (Roscoe, C. N. **37.** 25.)

Columbium *penta***chloride,** $CbCl_5$.

Decomp. by H_2O with separation of a hydrate of Cb_2O_5. Sol. in cold $HCl+Aq$, forming a solution which soon gelatinises, and separates out Cb_2O_5 by heat or dilution; with hot $HCl+Aq$, forms a cloudy solution which does not gelatinise. Sol. in H_2SO_4 to form a clear liquid which gelatinises on heating. Sol. in $KOH+Aq$. Sol. in alcohol with slight residue. (Rose, Pogg. **104.** 432.)

Columbium *penta***fluoride,** CbF_5.

Known only in solution in HF, in which a fluocolumbic acid H_2CbF_7 may also be assumed to exist.

Columbium fluoride *with* **MF.**

See **Fluocolumbate, M.**

Columbium hydride, CbH (?).

Insol. in HCl, HNO_3, and dil. H_2SO_4+Aq, even on boiling. Sol. in boiling conc. H_2SO_4 and in fused $KHSO_4$. Sol. in cold $HF+Aq$ if not too dilute. Also attacked by $KOH+Aq$. (Marignac, N. Arch. Phys. Nat. **31.** 89.)

Columbium hydroxide, Cb_2O_5, xH_2O.

See **Columbic acid.**

Columbium nitride.

Not attacked by boiling nitric acid or aqua regia, but sol. in a cold mixture of HNO_3 and HF. (Rose, Pogg. **111.** 426.)

Columbium *di***oxide,** Cb_2O_2.

Sol. when still moist in boiling dil. $HCl+Aq$. Insol. in hot HNO_3; less sol. in aqua regia than in $HCl+Aq$. Sol. in conc. H_2SO_4 after long heating. (Rose.)

Insol. in H_2O, KOH, or conc. acids, even when boiling. (Delafontaine.)

Columbium *tetr***oxide,** Cb_2O_4.

Not attacked by cold or hot H_2O, HCl, HNO_3, H_2SO_4, or aqua regia. Slightly attacked by boiling $KOH+Aq$. (Delafontaine.)

Columbium *pent***oxide,** Cb_2O_5.

When ignited insol. in hot conc. H_2SO_4. When it has not been ignited it forms a clear solution with H_2SO_4, which can be diluted without forming any precipitate. (Rose, Pogg. **112.** 549.)

Sol. in fused $KHSO_4$, which can be diluted with H_2O without causing pptn. Insol. in HF.

Columbium oxybromide, $CbOBr_3$.

Decomp. by H_2O into Cb_2O_5 and HBr. Sol. in hot H_2SO_4 and conc. $HCl+Aq$. (Rose, Pogg. **104.** 442.)

Columbium oxychloride, $CbOCl_3$.

Attracts H_2O from air without deliquescing and decomposes. Decomp. with H_2O with evolution of heat. Insol. in hot or cold $HCl+Aq$. Sol. by long contact with H_2SO_4 to a cloudy liquid, which clears up on warming, but soon separates out Cb_2O_5. Sol. in cold $KOH+Aq$ and hot K_2CO_3+Aq. (Rose.)

Sol. in alcohol, from which it is precipitated by ether. (Blomstrand.)

Columbium oxyfluoride, $CbOF_3$.

(Joly, C. R. **81.** 1266.)

Columbium oxyfluoride *with* **MF.**

See **Fluoxycolumbate,** *and* **Fluoxyhypocolumbate, M.**

Columbium oxysulphide, Cb_2OS_3.

Insol. in boiling $HCl+Aq$. Slowly decomp. into Cb_2O_5 by boiling with HNO_3 or aqua regia. Insol. in boiling dil. H_2SO_4+Aq. Converted into columbic sulphate, sol. in H_2O, by boiling conc. H_2SO_4. Sl. sol. in hot HF. Insol. in boiling K_2S+Aq. (Rose, Pogg. **111.** 193.)

Copper, Cu.

Copper is not attacked by distilled H_2O, or by NH_4NO_3, KNO_3, or $(NH_4)_2SO_4+Aq$, or by a mixture of those salts in solution. (Muir, cited by Carnelley, Chem. Soc. **30.** 1.)

Distilled H_2O has slight action on Cu. 100 ccm. H_2O dissolved from 2 sq. dcm. Cu from 0·035 mg. Cu in one hour up to 0·280 mg. in 72 hours. 100 ccm. H_2O dissolved 0·44 mg. from 6 sq. dcm. in 48 hours. Presence of solder diminishes solubility about one-half. At 90-100° the amount dissolved is about one-half that at ord. temp. (Carnelley, Chem. Soc. **30.** 1.)

100 ccm. distilled H_2O dissolved only 1 mg. Cu from 11·8 sq. cm. during a week, while air free from CO_2 was conducted through the solution. When the air contained CO_2, 3 mg. were dissolved. (Wagner, Dingl. **221.** 259.)

100 l. sea water dissolved 12·96 g. Cu from 1 sq. m. (Calvert and Johnson, C. N. **11.** 171.)

Solubility in H_2SO_4.

Not attacked by dil. H_2SO_4+Aq. (Vogel, Schw. J. **32.** 301.)

Action of H_2SO_4 at ordinary temp. is very slight even after a long time. (Barruel, J. Pharm. **20.** 13 [**1834**].)

H_2SO_4 has no action below 130°. (Calvert and Johnson, Chem. Soc. **19.** 438.)

H_2SO_4 acts slightly even at 20°.

16·3 g. H_2SO_4 (1·843 sp. gr.) dissolved the following amts. from 3 g. Cu, having a surface of 65 sq. cm. at the given temp.

Temp.	Time	% Cu dissolved
19°	14 days	About 6
60	120 min.	2·5
80	30 ,,	1·5
100	30 ,,	3·1
124	30 ,,	22·7
130	30 ,,	32·6
137	30 ,,	35·0
150	30 ,,	69·2
170	10 ,,	51·92
195	2 ,,	53·5
220	½ ,,	70·57
270	few seconds	nearly 100

With dilute acid the action was much less violent, as is seen in the following table—

Temp.	Time	Acid	Sp. gr.	% Cu dis-solved
100°	30 min.	H_2SO_4	1·843	2·380
100	30 ,,	$2H_2SO_4,H_2O$	1·8295	0·585
100	30 ,,	H_2SO_4, H_2O	1·780	0
100	30 ,,	$H_2SO_4,2H_2O$	1·620	0
130	30 ,,	H_2SO_4	1·843	32·6
130	30 ,,	H_2SO_4,H_2O	1·780	1·18
130	30 ,,	$H_2SO_4,2H_2O$	1·620	0
165	15 ,,	H_2SO_4	1·843	70
165	30 ,,	H_2SO_4,H_2O	1·780	16·5
165	30 ,,	$H_2SO_4,2H_2O$	1·620	2·7

(Pickering, Chem. Soc. **33.** 112.)

Cu is very sl. attacked by cold HCl + Aq of 1·12 sp. gr., but somewhat more on warming. Even less sol. in dil. HCl + Aq. (Löwe, Z. anal. **4.** 361.)

Sol. in warm conc. HI + Aq. (Rose.)

Slowly attacked by H_2SO_3 + Aq. (Causse, Bull. Soc. (2) **45.** 3.)

More or less sol. in all dil. mineral acids and also in organic acids, as acetic, tartaric, etc., when supply of air is afforded; but absolutely insol. in the latter acids when air is wholly excluded. The importance of this fact in the use of Cu cooking utensils is manifest.

Easily attacked by ord. HNO_3 + Aq.

With very conc. HNO_3 + Aq (sp. gr. 1·52) it becomes passive, as in the case of Fe.

Pure dil. HNO_3 + Aq of 1·07 sp. gr. or less does not attack Cu at 20°, but if NO_2 or KNO_2 is added the action begins at once. If HNO_3 + Aq is more conc. the Cu is attacked. HNO_3 + Aq of 1·108 sp. gr. begins to act at −2° and of 1·217 sp. gr. at −10°.

HNO_3 + Aq of 1·512 sp. gr. attacks Cu violently at 20°, but action soon ceases on account of formation of a crust of $Cu(NO_3)_2$, insol. in pure HNO_3. (Millon, A. ch. (3) **6.** 95.)

When in contact with the air, Cu is soon oxidised by acids, alkalies (especially NH_4OH + Aq), and many fatty bodies.

Sol. in $(NH_4)_2CO_3$ + Aq. (Traube, B. **18.** 1887.)

Slowly sol. in NH_4OH + Aq. (Schönbein, B. A. B. **1856.** 580.)

Sol. in KI + Aq when warm and conc. (Rose.)

When finely divided, Cu is easily sol. in hot $FeCl_3$ + Aq.

Action of dilute solutions of salts on solubility of Cu in H_2O.

100 ccm. solution of the following salts dissolve the amts. of Cu given below, from a surface of 1 sq. dcm. in 48 hours.

Salts	G. salt dissolved in 100 ccm. H_2O	Mg. Cu dissolved
H_2O	...	0·11
KNO_3	0·01 0·05 5·00	0·07 0·13 0·16
$NaNO_3$	0·05 5·00	0·18 0·19
$CaSO_4$	0·05	0·11
K_2SO_4	0·05 5·00	0·12 0·28
$MgSO_4$	0·05 5·00	0·16 0·34
Na_2CO_3	0·01 0·05 5·00	0·05 0·11 2·80
K_2CO_3	0·05 5·00	0·14 2·35
NaCl	0·01 0·05 5·00	0·05 0·18 7·50
KCl	5·00	8·17
$(NH_4)_2SO_4$	0·05 5·00	0·66 28·50
NH_4NO_3	0·01 0·05 5·00	0·17 0·66 60·00
NH_4Cl	0·05 5·00	0·92 158·75

At 100° the action of KNO_3, K_2SO_4, and NH_4NO_3 is diminished, while that of $(NH_4)_2SO_4$, Na_2CO_3, and NaCl is increased.

Tables are also given for mixtures of the above salts. (Carnelley, Chem. Soc. **30.** 1.)

Solubility of Cu in dilute salt solutions.

11·8 sq. cm. Cu were used, and the action continued one week, while air with or without CO_2 was passed through the solution continually.

100 ccm. solution of the following salts dissolved the given amts. Cu.

Salt	G. salt dissolved in 100 ccm. H_2O	Mg. Cu dissolved without CO_2	Mg. Cu dissolved with CO_2
NaCl	0·50	4	115
KCl	0·50	4	115
$MgCl_2$	0·83	5	112
NH_4Cl	1·00	904	138
K_2SO_4	1·00	0	4
KNO_3	1·00	0	3
Na_2CO_3	1·00	0	...
NaOH	0·923	0	...
CaO_2H_2	sat.	0	...

(Wagner, Dingl. **221.** 260.)

Distilled H_2O dissolved no Cu from 420 sq. mm. in 150 hours at ord. temp.

NH_4NO_3+Aq with less than 0·4 g. per litre showed the same result.

KNO_3+Aq or $(NH_4)_2SO_4+Aq$ containing 0·1 to 0·2 g. per litre dissolved no Cu.

H_2O containing carbonates + nitrates, carbonates + sulphates, or chlorides + nitrates also dissolved no Cu.

NH_4NO_3+Aq containing 0·4 g. per litre dissolved 3 mg. per litre after 150 hours' contact.

From a surface of 2100 sq. m. of Cu, H_2O charged with CO_2 at ord. pressure, and containing the following salts in solution, dissolved the given amts. Cu in 120 hours.

Salt	G. salt dissolved in 1 l. H_2O	Mg. Cu dissolved
H_2O	...	1·0
K_2CO_3	0·2	0·2
$CaCl_2$	0·2	1·80
NH_4NO_3	0·02	1·40
NH_4NO_3	0·04	1·40
K_2CO_3	0·1	1·00
NH_4NO_3	0·02	
K_2CO_3	0·2	0·1
NH_4NO_3	0·04	
NH_4NO_3	0·2	3·6
$CaCl_2$	0·2	

From a surface of 2100 sq. m., H_2O charged with CO_2 at pressure of 6 atmos. dissolved 0·6 mg. in 48 hours.

H_2O when charged with CO_2 at 6 atmos. and containing:

16 mg. NH_4NO_3 per litre, dissolved 0·8 mg. in 48 hours.

80 mg. NH_4NO_3 per litre, dissolved 1·4 mg. in 48 hours.

40 mg. K_2CO_3 per litre, dissolved 1·2 mg. in 48 hours. (Muir, Proc. Soc. Manchester, **15.** 31.)

Amts. Cu dissolved by action of various oils on 8 sq. in. Cu by 10 days' exposure and subsequent 67 days—

	Amt. Cu dissolved in 10 days	Amt. Cu dissolved in subsequent 67 days
Linseed oil .	0·3000 grain	0·2435 grain
Olive oil . .	0·2200 ,,	0·0200 ,,
Colza oil . .	0·0170 ,,	0·1230 ,,
Almond oil .	0·1030 ,,	0·1170 ,,
Seal oil . .	0·0485 ,,	0·0315 ,,
Sperm oil . .	0·0030 ,,	0·0575 ,,
Castor oil . .	0·0065 ,,	0·0035 ,,
Neatsfoot oil .	0·1100 ,,	...
Sesame oil .	0·1700 ,,	0·0015 ,,
Paraffine oil .	0·0015 ,,	...

(Watson, C. N. **36.** 200.)

Qualitative results of the action of various oils on Cu are also given by Thompson. (C. N. **34.** 176, 200, 219.)

Cupric arsenide, Cu_5As_2.

(Reinsch, J. pr. **24.** 244.)

Cu_4As_2. (Gehlen.)

Cu_3As_2. Ppt. Decomp. by acids. (Kane, Pogg. **44.** 471.)

Cu_3As. Min. *Domeykite.* Insol. in HCl + Aq ; sol. in HNO_3.

Cu_6As. Min. *Algodonite.*

Cu_9As. Min. *Darwinite.*

Cuprous azoimide.

Insol. in H_2O. (Curtius.)

Cuprous bromide, Cu_2Br_2.

Insol. in H_2O. Sol. in HBr, HCl without decomp., or HNO_3+Aq with decomp., also in NH_4OH+Aq. Insol. in boiling conc. H_2SO_4 or $HC_2H_3O_2+Aq$. (Berthemot, A. ch. **44.** 385.)

Sol. in NaCl, and $Na_2S_2O_3+Aq$. (Renault, C. R. **59.** 319.)

Cupric bromide, $CuBr_2$.

Deliquescent. Very sol. in H_2O. Insol. in benzene. (Franchimont, B. **16.** 387.)

$+xH_2O$. Very deliquescent, and sol. in H_2O.

Cupric bromide ammonia, $CuBr_2$, $2NH_3$.

Sol. in NH_4Br+Aq without decomp. (Richards, B. **23.** 3790.)

$3CuBr_2$, $10NH_3$. Decomp. by H_2O. (Richards, Am. Ch. J. **15.** 651.)

$CuBr_2$, $3NH_3$. Completely sol. in a little H_2O, but is decomp. by dilution. Insol. in alcohol. (Rammelsberg, Pogg. **55.** 246.)

$CuBr_2$, $5NH_3$. As above. (Rammelsberg.)

$CuBr_2$, $6NH_3$. Sol. in small amts. H_2O, but decomp. on dilution. (Richards.)

Cuprous chloride, Cu_2Cl_2.

Insol. in H_2O.

Sol. in conc. $HCl+Aq$; insol. in dil. HNO_3, or H_2SO_4+Aq. Not attacked by cold conc. H_2SO_4, and only sl. on warming. (Rosenfeld, B. **12.** 954.) Sol. in NH_4OH+Aq; sol. in hot NaCl, KCl, $FeCl_3$, $ZnCl_2$, $MnCl_2$, etc. +Aq. 1 mol. $Na_2S_2O_3$ in aqueous solution dissolves 1 mol. Cu_2Cl_2. (Winkler, J. pr. **88.** 428.) Sol. in KI, I_2, KCN, or $(NH_4)_2SO_4+Aq$. (Renault, C. R. **59.** 558.)

Solubility in HCl+Aq at 17°. $\frac{Cu_2Cl_2}{2}=\frac{1}{2}$ mols. $CuCl_2$ in mgs. in 10 ccm. solution. HCl= mols. HCl in ditto.

$\frac{Cu_2Cl_2}{2}$	HCl	Sp. gr.
0·475	8·975	1·050
1·4	15·7	...
1·575	18·2	...
4·5	34·5	1·080
8·25	47·8	1·135
11·5	57·0	...

(Chatelier, calc. by Engel, A. ch. (6) **17.** 377.)

Solubility of Cu_2Cl_2 in HCl+Aq at 0°.

$\frac{Cu_2Cl_2}{2}$	HCl	Sp. gr.
1·5	17·5	1·049
2·9	26·0	1·065
8·25	44·75	1·132
15·5	68·5	1·261
33·0	104·0	1·345

(Engel, *l.c.*)

Solubility in NaCl+Aq.

Sat. NaCl+Aq dissolves 16·9 % Cu_2Cl_2 at 90°; 11·9 % at 40°; and 8·9 % at 11°.

15 % NaCl+Aq dissolves 10·3 % Cu_2Cl_2 at 90°; 6·0 % at 40°; and 3·6 % at 14°.

5 % NaCl+Aq dissolves 2·6 % Cu_2Cl_2 at 90°, and 1·1 % at 40°. (Hunt, Sill. Am. J. (2) **49.** 154.)

Insol. in alcohol.

Sl. sol. in ether. (Gehlen.)

Min. *Nantokite.* Sol. in HCl, HNO_3, or NH_4OH+Aq.

Cupric chloride, $CuCl_2$.

Deliquescent. 100 pts. H_2O dissolve 70·6 pts. $CuCl_2$ at 0°; 100 pts. $CuCl_2+Aq$ contain 41·4 pts. $CuCl_2$. (Engel, A. ch. (6) **17.** 350.)

100 pts. H_2O dissolve 76·2 pts. $CuCl_2$ at 16·1°, or 100 pts. $CuCl_2+Aq$ sat. at 16·1° contain 43·25 pts. $CuCl_2$. (Rüdorff, B. **6.** 484.)

100 pts. $CuCl_2+Aq$ sat. at 17° contain 43·06 pts. $CuCl_2$; at 31·5°, contain 44·7 pts. $CuCl_2$. Coefficient of solubility = 41·4 + 0·105t. (Reicher and Deventer, Z. phys. Ch. **5.** 560.)

+H_2O. (Ditte, A. ch. (5) **22.** 551.)

+$2H_2O$. Deliquescent. 100 g. H_2O dissolve 121·4 g. $CuCl_2+2H_2O$ at 16·1°. (Rüdorff.)

Sp. gr. of $CuCl_2+Aq$ at 17·5°.

% $CuCl_2$	Sp. gr.	% $CuCl_2$	Sp. gr.
5	1·0455	25	1·2918
10	1·0920	30	1·3618
15	1·1565	35	1·4447
20	1·2223	40	1·5284

(Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $CuCl_2+Aq$ at 22·9°, containing in 1000 g. H_2O, g. $CuCl_2+2H_2O$.

85·5 (=½ mol.) 171 255·5 g. $CuCl_2+2H_2O$,
1·057 1·108 1·154

342 427·5 513 598·5 684 g. $CuCl_2+2H_2O$,
1·197 1·238 1·275 1·309 1·341

769·5 855 940·5 1·026 g. $CuCl_2+2H_2O$.
1·371 1·399 1·425 1·449

Containing $CuCl_2$ (anhydrous).

67·5 (=½ mol.) 135 202·5 270 g. $CuCl_2$,
1·059 1·114 1·165 1·213

337·5 405 472·5 540 607·5 675 g. $CuCl_2$.
1·257 1·299 1·340 1·379 1·416 1·453

(Gerlach, Z. anal. **28.** 468.)

Sp. gr. of $CuCl_2+Aq$ at 0°. S=pts. $CuCl_2$ in 100 pts. solution; S_1=mols. $CuCl_2$ in 100 mols. of solution.

S	S_1	Sp. gr.
39·4170	8·00	1·4797
35·3839	6·82	1·4173
30·9255	5·65	1·3529
26·1129	4·51	1·2881
20·6697	3·36	1·2204
14·5820	2·23	1·1494
8·0732	1·16	1·0796

(Charpy, A. ch. (6) **29.** 25.)

Tables for 7°, 30·5°, 49·2°, and 65° are also given by Charpy.

Not decomp. by cold H_2SO_4. Sol. in NH_4Cl+Aq. Very sol. in conc. NaCl+Aq. (Boussingault.)

100 g. H_2O dissolve 72·6 g. $CuCl_2$+16·0 g. NaCl. (Rüdorff, B. **6.** 684.)

Solubility in HCl+Aq at 0°. $\frac{CuCl_2}{2}=\frac{1}{2}$ mols. in milligrammes in 10 ccm. solution. HCl =mols. HCl in ditto; H_2O=g. H_2O.

$\frac{CuCl_2}{2}$	HCl	Sum of equiv.	Sp. gr.	H_2O
91·75	0	91·75	1·490	8·73
86·8	4·5	91·3	1·475	8·74
83·2	7·8	91	1·458	...
79·35	10·5	89·85	1·435	8·64
68·4	20·25	88·65	1·389	8·56
50·0	37·5	87·5	1·319	8·47
22·8	70·25	93·05	1·231	8·21
23·5	102·5	126	1·288	7·56
26·7	128	154·7	1·323	6·77

(Engel, A. ch. (6) **17.** 351.)

Sol. in alcohol and ether.

Sol. in 1 pt. strong alcohol.

100 pts. absolute methyl alcohol dissolve 68 pts. $CuCl_2$ at 15·5°; 100 pts. absolute ethyl alcohol dissolve 53 pts. $CuCl_2$ at 15·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in benzene.

Cupric hydrogen chloride, $CuCl_2$, $HCl+3H_2O$.

Decomp. by H_2O. Sol. in $HCl+Aq$ below 0°. (Engel, C. R. **106.** 273.)

$CuCl_2$, $2HCl+5H_2O$. Properties as above. (Sabatier, C. R. **106.** 1724.)

Cupric lithium chloride, $CuCl_2$, $LiCl+2\frac{1}{2}H_2O$.

Decomp. on air. Decomp. by dissolving in H_2O. Sol. in conc. $LiCl+Aq$ without decomp. Decomp. by alcohol. (Chassevant, A. ch. (6) **30.** 33.)

$+2H_2O$. (Meyerhoffer, W. A. B. **100, 2b.** 621.)

Cupric mercuric chloride.

Easily sol. in H_2O. (v. Bonsdorff.)

Cupric mercuric potassium chloride, $CuCl_2$, $3HgCl_2$, $6KCl+2H_2O$.

Deliquescent in moist air. Sol. in boiling H_2O without decomp., and recrystallises if cooled slowly. Insol. in absolute alcohol. (v. Bonsdorff, Pogg. **33.** 81.)

Cuprous nitrosyl chloride, Cu_2Cl_2, $2NOCl$.

Very deliquescent and sol. in H_2O with immediate decomp. (Sudborough, Chem. Soc. **59.** 658.)

Cupric potassium chloride, $CuCl_2$, $2KCl+2H_2O$.

Sol. in H_2O and alcohol. (Berzelius, Pogg. **13.** 458.)

$CuCl_2$, KCl. (Meyerhoffer, Z. phys. Ch. **3.** 336.)

Cuprous potassium chloride, Cu_2Cl_2, $4KCl$.

Sol. in H_2O. (Mitscherlich, A. ch. **73.** 384.)

Cupric rubidium chloride, $CuCl_2$, $2RbCl$.

Easily sol. in H_2O and $HCl+Aq$. (Godeffroy, B. **8.** 9.)

$+2H_2O$. Sol. in H_2O. (Wyrouboff, J. B. **1887.** 538.)

Cuprous sodium chloride.

Very sol. in H_2O.

Cupric sodium chloride.

Easily sol. in conc. $NaCl+Aq$. Sol. in alcohol of 0·837 sp. gr.

Cupric thallic chloride, $CuCl_2$, $2TlCl_3$.

Sol. in H_2O. (Willm, A. ch. (4) **5.** 55.)

Cuprous chloride ammonia, Cu_2Cl_2, $2NH_3$.

Decomp. by H_2O or acids, not by alcohol. (Ritthausen, J. pr. **59.** 369.)

Cupric chloride ammonia, $CuCl_2$, $2NH_3$.

Decomp. by H_2O. (Kane, A. ch. **72.** 273.)

$CuCl_2$, $4NH_3 + H_2O$ (*Cuprammonium chloride*). Sol. in H_2O and hot NH_4OH+Aq.

$CuCl_2$, $6NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20.** 55.)

Cuprocupric chloride ammonia, Cu_2Cl_2, $CuCl_2$, $4NH_3+H_2O$.

Decomp. by H_2O or alcohol. Abundantly sol. in NH_4Cl+Aq, but with partial decomposition. (Ritthausen.)

Cupric chloride ammonia platinous chloride, $CuCl_2$, $4NH_3$, $PtCl_2$.

See **Plato*di*amine cupric chloride.**

Cuprous chloride carbon *mon*oxide, $4Cu_2Cl_2$, $3CO+7H_2O$.

Insol. in H_2O, but decomp. therewith very quickly. Sol. in Cu_2Cl_2+HCl.

Cuprous chloride mercuric sulphide, Cu_2Cl_2, $2HgS$.

Insol. in H_2O; sol. in conc. hot $HCl+Aq$; not decomp. by boiling dil. H_2SO_4+Aq, but decomp. by conc. H_2SO_4. (Heumann, B. **7.** 1390.)

Cuprous fluoride, Cu_2F_2.

Insol. in H_2O or HF. Sol. in conc. $HCl+Aq$, from which it is precipitated by H_2O. Insol. in alcohol. (Berzelius, Pogg. **1.** 28.)

Decomp. by H_2O into sol. CuF_2. Sol. in boiling $HCl+Aq$ and in HNO_3+Aq. Only sl. attacked by warm H_2SO_4. (Poulenc, C. R. **116.** 1447.)

Cupric fluoride, CuF_2.

Easily takes up H_2O to form CuF_2+2H_2O. Sol. in HCl, HNO_3, or $HF+Aq$. (Poulenc, C. R. **116.** 1448.)

$+2H_2O$. Sl. sol. in cold, decomp. by hot H_2O. (Berzelius.)

Cupric potassium fluoride, CuF_2, $2KF$.

Easily sol. in H_2O.

CuF_2, KF. Very sl. sol. in H_2O; sl. sol. in dil. acids. (Helmholt, Z. anorg. **3.** 115.)

Cupric rubidium fluoride, CuF_2, RbF.

As the K salt. (Helmholt.)

Copper stannic fluoride.

See **Fluostannate, copper.**

Copper tantalum fluoride.

See **Fluotantalate, copper.**

Copper titanium fluoride.

See **Fluotitanate, copper.**

Copper tungstyl fluoride.

See **Fluoxytungstate, copper.**

Copper zirconium fluoride.

See **Fluozirconate, copper.**

Copper hydride, Cu_2H_2.

Insol. in H_2O. Sol. in $HCl+Aq$. (Wurtz, C. R. **18.** 102.)

Cuprous hydroxide, Cu_2O, xH_2O.

Sol. in acids as cupric salt. Insol. in NaOH, or $KOH+Aq$.

Sol. in NH_4OH, and $(NH_4)_2CO_3+Aq$; sol. in $Na_2S_2O_3+Aq$.

Cupric hydroxide, $3CuO, H_2O$.

Insol. in H_2O or dil. alkalies. Easily sol. in warm NH_4Cl+Aq. (Rose.)

Much more difficultly sol. than CuO_2H_2 in $KOH+Aq$. (Chodnew, J. pr. **28.** 220.)

True composition is $6CuO, H_2O$.

See also **Cupric oxide.**

CuO_2H_2. Insol. in H_2O, but decomp. into $6CuO, H_2O$ by being boiled therewith.

Extremely easily sol. in acids.

Sol. in NH_4OH, and NH_4 salts $+Aq$.

Sol. in cold NaOH, or $KOH+Aq$ (Proust); but CuO is pptd. on boiling (Berthollet); is not pptd. (Chodnew, J. pr. **28.** 220.)

Insol. in NaOH or $KOH+Aq$ unless they contain organic matter (Berzelius). This is contradicted by Völcker (A. **59.** 34).

Entirely sol. in conc. $KOH+Aq$, but solution is decomp. by heating. (Fremy, A. ch. (3) **12.** 510.)

Sol. in $NaOH+Aq$ (70 % NaOH). (Löw, Z. anal. **9.** 463.)

Sl. sol. in alkali carbonates $+Aq$, especially $KHCO_3$ and $NaHCO_3$. (Berzelius.)

Sol. in cold $Na_2S_2O_3+Aq$, but pptd. on warming. (Field, Chem. Soc. (2) **1.** 28.)

Partially sol. when freshly pptd. in KCN $+Aq$. (Rodgers, **1834.**)

Moderately sol. in amylamine, easily sol. in methyl-, less in ethylamine. (Wurtz.)

Sol. in large amt. in $NaC_2H_3O_2+Aq$. (Mercer, **1844.**)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in cane sugar $+Aq$, unless an alkali or alkaline earth is present. (Peschier.)

Recently pptd. CuO_2H_2 is easily sol. in cane sugar with NaOH, KOH, or CaO_2H_2+Aq; less sol. in presence of SrO_2H_2 or BaO_2H_2. (Becquerel.)

Not pptd. by $KOH+Aq$ in solutions containing tartaric acid, cane sugar, and many other non-volatile organic substances.

Sol. in Ca, Ba, Sr, K or Na sucrates $+Aq$, and ppts. of double sucrates form when solutions of the first three bases are heated, but no ppt. forms in the last two cases even at 100°. (Hunton.)

Insol. in simple Ca, Ba, or K sucrates $+Aq$, but immediately sol. when an excess of cane sugar $+Aq$ is present. (Peligot.)

Sol. in sorbine $+Aq$. (Pelouze.)

Not pptd. in presence of aromatic oxyacids or phenols of the ortho series. Thus in presence of salicylic acid, pyrocatechin, gallic acid, pyrogallic acid, etc., $NaOH+Aq$ does not ppt. CuO_2H_2 from Cu solutions, but pptn. is not prevented by oxybenzoic, paroxybenzoic acids, resorcin, hydrochinone, etc. (Weith, B. **9.** 342.)

Cuprous iodide, Cu_2I_2.

Insol. in H_2O, or dil. acids. Calculated from electrical conductivity of Cu_2I_2+Aq, 1 l. H_2O dissolves about 8 mg. Cu_2I_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Sol. with difficulty in conc. $HCl+Aq$.

Decomp. by conc. HNO_3, or H_2SO_4. Insol. in NaCl, KNO_3, Na_2SO_3, KBr, or NH_4Cl+Aq. Sol. in NH_4OH, $Na_2S_2O_3$, KCN, or $KI+Aq$. (Renault, C. R. **59.** 558.)

Cupric iodide, CuI_2.

Exists only in very dil. aqueous solution. (Traube, B. **17.** 1064.)

Cuprous mercuric iodide, Cu_2I_2, HgI_2.

$KI+Aq$ dissolves out HgI_2.

Cuprous mercuric iodide ammonia, $CuI_2, 2HgI_2, 4NH_3$.

Decomp. by H_2O or acids. Sol. in a mixture of acetic acid and alcohol.

$CuI_2, HgI_2, 4NH_3$. As above. (Jörgensen, J. pr. (2) **2.** 347.)

Cupric nitrogen iodide, $CuI_2, N_2H_4I_2$.

Decomp. by H_2O; or NH_4OH+Aq. (Guyard, C. R. **97.** 526.)

Cupric thallic iodide ammonia, $CuI_2, 2TlI_3, 4NH_3$.

Decomp. slowly by H_2O. Sol. in NH_4OH+Aq with decomp. Sol. in alcohol.

Cuprous iodide ammonia, $Cu_2I_2, 4NH_3$.

(Levol, J. Pharm. **4.** 328.)

$+H_2O$. (Saglier, C. R. **104.** 1440.)

Cupric iodide ammonia, $CuI_2, 4NH_3+H_2O$.

Decomp. by H_2O. Sol. in NH_4OH+Aq without decomp. Not attacked by cold alcohol or ether. (Berthemot, J. Pharm. **15.** 445.)

Copper *tetra*iodide ammonia, $CuI_4, 4NH_3$.

(Jörgensen, J. pr. (2) **2.** 353.)

Copper *hexa*iodide ammonia, $CuI_6, 4NH_3$.

Not decomp. in H_2O in closed vessels. (Jörgensen.)

Copper nitride, Cu_6N_2.

Decomp. by dil. or conc. acids.

Copper *sub*oxide, Cu_4O.

Not attacked by H_2O. Decomp. by dil. H_2SO_4+Aq into Cu and $CuSO_4$; dil. $HCl+Aq$ has similar action. Not attacked by NH_4OH+Aq or $NH_4OH+(NH_4)_2CO_3+Aq$. (Rose, Pogg. **120.** 1.)

Cuprous oxide, Cu_2O.

Insol. in H_2O. Decomp. by H_2SO_4+Aq, H_3PO_4+Aq, or cold very dil. HNO_3+Aq into a cupric salt and Cu. Converted by $HCl+Aq$ into cuprous chloride.

Sol. in boiling NH_4Cl+Aq. (Rose.)

Sl. sol. in excess of $KOH+Aq$. (Chodnew.)

Sol. in conc. $MgCl_2$, and $FeCl_3+Aq$. (Hunt, C. R. **69.** 1357.)

Min. *Cuprite.* Sol. in HCl, HNO_3, and NH_4OH+Aq.

Cupric oxide, CuO.

Insol. in H_2O. Easily sol. in acids. Sol. in H_2SO_3+Aq. Insol. in NH_4OH+Aq, but dissolves on addition of a few drops of acid or $(NH_4)_2CO_3+Aq$. Insol. in dil., but sol. in warm conc. NaOH, and $KOH+Aq$. (Löw, Z. anal. **9.** 463.)

Slowly sol. in Ca or any other alkali sucrate $+Aq$, but not in cane sugar $+Aq$.

(Hunton.) Slowly sol. in boiling NH_4Cl+Aq, and less easily in NH_4NO_3+Aq. (Rose.)

Sol. in boiling H_2O solutions of Al_2, Gl, U, Cr_2, Fe_2, or Bi nitrates and chlorides, $Hg(NO_3)_2$, $Hg_2(NO_3)_2$, $SbCl_3$, $SnCl_2$, and $SnCl_4$, with pptn. of oxides of the bases of those salts. Unacted upon by boiling H_2O solutions of Mn, Mg, Ni, Co, Zn, Ce_2, or Fe nitrates or chlorides, $AgNO_3$, $Pb(NO_3)_2$, $Cd(NO_3)_2$, and $HgCl_2$. (Persoz.)

Solubility in (calcium sucrate + sugar) + Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 10·26 g. CuO.

1 l. solution containing 296·5 g. sugar and 24·2 g. CaO dissolves 5·68 g. CuO.

1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 3·47 g. CuO. (Bodenbender, J. B. **1865.** 600.)

$+\frac{1}{6}H_2O=6CuO+H_2O$. Insol. in dil., but sol. in conc. KOH or $NaOH+Aq$.

Sol. in volatile oils.

See also **Cupric hydroxide.**

Min. *Melaconite.* Sol. in HCl, or HNO_3+Aq.

Cuprocupric oxide, $Cu_5O_3=2Cu_2O, CuO$.

(Favre and Maumené.)

$Cu_3O_2+H_2O=Cu_2O, CuO+H_2O$. When freshly pptd., sol. in $HCl+Aq$, but insol. after drying. (Siewert, J. B. **1866.** 257.)

$Cu_4O_3=Cu_2O, 2CuO$. (Siewert.)

All oxides of Cu except Cu_4O, Cu_2O, CuO, and CuO_2 are mixtures. (Osborne, Sill. Am. J. (3) **32.** 33; Debray, C. R. **99.** 583.)

Copper *di*oxide, CuO_2+H_2O.

Insol. in H_2O. Decomp. by acids with formation of cupric salt and H_2O_2. (Weltzien, A. **140.** 207.)

Cuprous oxide ammonia (cuprosammonium oxide).

Known only in solution. (Wagner, C. C. **1863.** 239.)

Cupric oxide ammonia (cuprammonium hydroxide), $3CuO, 4NH_3+6H_2O$.

Insol. in H_2O. (Kane, A. ch. **72.** 283.)

$CuO, 4NH_3+4H_2O$. Very deliquescent. Decomp. in the air and by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9.** 438.)

Cuprous oxybromide, $Cu_2Br_2, CuO+H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxybromide.

Insol. in H_2O. (Löwig.)

$CuBr_2, 3CuO+3H_2O$. Insol. in H_2O. Easily sol. in dil. acids or NH_4OH+Aq. (Brun, C. R. **109.** 66.)

Cuprous oxychloride, $Cu_2Cl_2, CuO+3H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxychloride, $2CuO, CuCl_2$.

Insol. in H_2O. Sol. in $HCl+Aq$, from which it is reprecipitated by dilution with H_2O.

$+H_2O$. (Kane, A. ch. **72.** 277.)

$+4H_2O$. (Gladstone, Chem. Soc. **8.** 211.)

$3CuO, CuCl_2+3\frac{1}{2}H_2O$. Insol. in cold H_2O, sl. decomp. by boiling. (Reindel, J. pr. **106.** 378.)

Insol. in boiling H_2O. (Habermann, W. A. B. **90, 2.** 268.)

$+4H_2O$ (*Brunswick green*). Insol. in H_2O. Easily sol. in acids.

Min. *Atacamite.* Sol. in acids, and NH_4OH+Aq.

$7CuO, 2CuCl_2+9H_2O$. (Reindel.)

$6CuOCuCl_2+9H_2O$. Insol. in H_2O. Sol. in acetic acid. (Neumann, Repert, **37.** 304.)

Cupric oxyfluoride, CuO, CuF_2+H_2O.

Insol. in H_2O. (Berzelius.)

(Balbiano, Gazz. ch. it. **14.** 74.)

Cupric oxyfluoride ammonia (cuprammonium oxyfluoride), $Cu(OH)F, 2NH_3$.

(Balbiano, Gazz. ch. it. **14.** 74.)

Cuprous oxyiodide, $Cu_2I_2, CuO+H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxyiodide, $2CuI_2, CuO+4H_2O$.

Easily decomp. by H_2O. (Carnegie, Watts' Dict. II. 257.)

Copper oxysulphide, $2Cu_2S, CuO$.

Insol. in H_2O. (Maumené, A. ch. (3) **18.** 311.

$5CuS, CuO$. Ppt. (Pelouze.)

$2CuS, CuO$. Insol. in H_2O.

CuS, CuO. Insol. in H_2O.

Above comps. do not exist. (Pickering, Chem. Soc. **33.** 136.)

Copper phosphide, Cu_6P_2.

Easily sol. in HNO_3 or aqua regia; insol. in $HCl+Aq$. (Rose, Pogg. **6.** 209.)

Cu_4P_2 (?). (Hvoslef, A. **100.** 100.)

Cu_3P_2. Easily sol. in HNO_3. Sol. in hot conc. H_2SO_4. Sol. in conc. $HCl+Aq$ before the phosphide has been heated. (Rose, Pogg. **4.** 110.)

Cu_2P_2. Easily sol. in HNO_3, or $HCl+Aq$. Sol. in NH_4OH+Aq. (Granger, Bull. Soc. (3) **9.** 661.)

Cupric zinc phosphide, $10Cu_6P_2, Zn_6P_2$ (?).

(Hvoslef, A. **100.** 99.)

Copper phosphoselenide, $CuSe, P_2Se$.

Insol. in H_2O or $HCl+Aq$; sol. in HNO_3+Aq. Insol. in cold alkalies, but decomp. slowly when heated therewith. (Hahn, J. pr. **93.** 436.)

$2CuSe, P_2Se_3$. Attacked only by fuming HNO_3. (Hahn.)

$2CuSe, P_2Se_5$. Sol. only in HNO_3+Aq. (Hahn.)

Copper phosphosulphide, $2Cu_2S, P_2S$.

Cu_2S, P_2S. (Berzelius.)

$2Cu_2S, P_2S_3$.

CuS, P_2S. Insol. in H_2O and dil. $HCl+Aq$. Sol. in conc. $HCl+Aq$, from which it is precipitated by H_2O. (Berzelius, A. **46.** 252.)

$8CuS, P_2S_5$. (Berzelius.)

Cuprous selenide, Cu_2Se.

Min. *Berzelianite.*

Cupric selenide, CuSe.

(Little, A. **112.** 211.)

Cuprous lead selenide, $3Cu_2Se$, PbSe.

Min. *Zorgite.* Sol. in cold conc. HNO_3+Aq with separation of Se.

Cupric lead selenide, CuSe, PbSe.

Sol. in cold conc. HNO_3 with separation of Se. (Karsten.)

CuSe, 2PbSe. As above.

CuSe, 4PbSe. As above.

Cuprous silver selenide, Cu_2Se, Ag_2Se.

Min. *Eucainite.* Sol. in hot HNO_3 with decomp. (Berzelius.)

Cuprous sulphide, Cu_2S.

Cold HNO_3+Aq dissolves out Cu and leaves CuS; hot HNO_3 dissolves with separation of S. Sl. sol. in boiling conc. HCl+Aq. Insol. in $(NH_4)_2S$+Aq.

Min. *Chalcocite.* Completely sol. in warm HNO_3 with separation of S.

Cupric sulphide, CuS.

Almost absolutely insol. in H_2O; sol. in 950,000 pts. H_2O. When exposed to the air, dissolves in H_2O as $CuSO_4$. Easily sol. in boiling HNO_3 with separation of S. Difficultly sol. in hot conc. HCl+Aq. Insol. in dil. H_2SO_4+Aq (1 : 6). (Hoffmann, A. **115.** 286.)

Insol. in KOH, or K_2S+Aq, especially if boiling; appreciably sol. in colourless and even more readily in hot yellow $(NH_4)_2S$+Aq.

Sl. sol. in Na_2S+Aq, more easily in NaSH+Aq. (Becker, Sill. Am. J. (3) **33.** 199.)

Sol. in considerable quantity in alkali sulpharsenates, sulphantimonates, and sulphostannates +Aq. Therefore when a mixed ppt. of CuS and As_2S_3, Sb_2S_3, or SnS is treated with K_2S, a portion of the CuS is dissolved. (Wöhler, A. **34.** 236.)

Sol. in alkali sulphovanadates, or sulphotungstates +Aq. (Storch, B. **16.** 2015.)

Sol. in alkali sulphomolybdates + Aq. (Debray, C. R. **96.** 1616.)

Insol. in K thiocarbonate + Aq. (Rosenbladt, Z. anal. **26.** 15.)

Sol. in $(NH_4)_2CO_3$+Aq. (Berzelius.) Sol. in alkali bicarbonates +Aq.

Insol. in NH_4NO_3, or NH_4Cl+Aq. (Brett.)

Sol. in KCN+Aq.

Pptd. by H_2S or $(NH_4)_2S$+Aq in presence of 100,000 pts. H_2O (Pfaff), 200,000 pts. H_2O (Lassaigne), 15,000 pts. H_2O and 7500 pts. HCl, but with 40,000 pts. H_2O and 20,000 pts. HCl no colour is visible (Reinsch).

Min. *Covellite.*

Colloidal. Aqueous solution is stable when it contains 5 g. CuS in a litre; when it contains 4 or 5 times that amount it is decomposed in an hour.

Solutions of salts of the following concentration cause a precipitate in the above solution.

Salts of univalent elements—

$K_3Fe(CN)_6$	1 : 62
$K_4Fe(CN)_6$	1 : 127
$Na_2S_2O_3$	1 : 157
Na_2CO_3	1 : 200
Na_2HPO_4	1 : 252
Na_2SO_4	1 : 333
$K_2Cr_2O_7$	1 : 2083
KI	1 : 80
KBr	1 : 133
$KClO_3$	1 : 166
$NaC_2H_3O_2$	1 : 221
$(NH_4)_2C_2O_4$	1 : 255
NaCl	1 : 400
$NaHCO_3$	1 : 2500
K_2SO_4	1 : 117
K_2CrO_4	1 : 133
$NaC_7H_5O_2$	1 : 166
$K_2S_2O_6$	1 : 222
KCl	1 : 333
KNO_3	1 : 500

Salts of bivalent metals—

BaS_2O_6	1 : 2242
$Cd(NO_3)_2$	1 : 3483
$MgSO_4$	1 : 6830
$Ba(NO_3)_2$	1 : 2677
$BaCl_2$	1 : 3921
$Pb(ClO_3)_2$	1 : 6988
$CdSO_4$	1 : 3442
$MnSO_4$	1 : 5518

Salts of trivalent metals—

Ammonia alum	1 : 31,896
Chrome alum	1 : 58,889
$Al_2(SO_4)_3$	1 : 90,909

Acids—

Succinic	1 : 100
Oxalic	1 : 162
HCl	1 : 733
H_2SO_4	1 : 208
Citric	1 : 20
Acetic	Not at all
Tartaric	,, ,,

(Spring and de Boeck, Bull. Soc. (2) **58.** 165.)

Cuprous ferric sulphide, Cu_2S, Fe_2S_3.

Decomp. by conc. HCl+Aq. Sol. in boiling HNO_3+Aq of 1·2 sp. gr. (Schneider, J. pr. (2) **38.** 569.)

Min. *Chalcopyrite.* Insol. in HCl+Aq. When heated in a sealed tube with H_2S+Aq, a portion of it dissolves with difficulty and subsequent deposition. (Senarmont, A. ch. (3) **32.** 168.)

Cuprocupric ferrous sulphide, Cu_2S, CuS, FeS.

Min. *Bornite.* Sol. in HCl+Aq with a residue of S.

Cupric ferrous sulphide, CuS, Fe_2S_3.

Min. *Cubanite.*

Copper iron potassium sulphide, $K_2FeCu_3S_4$.

Sl. attacked by cold dil. HCl+Aq. Decomp. by warming. (Schneider, Pogg. **138.** 318.)

Copper iron sodium sulphide, $Na_2FeCu_3S_4$.

Sl. attacked by cold dil., easily decomp. by hot HCl + Aq. (Schneider, Pogg. **138.** 318.)

Cuprous lead sulphide, $9Cu_2S, 2PbS$.

$3Cu_2S, 2PbS$.

$2Cu_2S, 2PbS$. Min. *Cuproplumbite.*

Copper phosphorus sulphide.

See **Copper phosphosulphide.**

Cupric platinum sulphide.

See **Sulphoplatinate, cupric.**

Cuprous potassium sulphide, $4Cu_2S, K_2S$.

(Ditte, C. R. **98.** 1429.)

Copper potassium sulphide, $2CuS_3, K_2S$.

Decomp. by H_2O, NH_4OH, or NH_4SH + Aq. (Priwoznik, B. **5.** 1291.)

Cuprocupric potassium sulphide, $3Cu_2S, 2CuS, K_2S$.

Not decomp. by very dil. HCl + Aq, but easily by conc. HCl + Aq on warming. (Schneider, Pogg. **138.** 311.)

Cuprous silver sulphide, Cu_2S, Ag_2S.

Min. *Stromeyerite.* Sol. in HNO_3 + Aq with separation of S.

$Cu_2S, 3Ag_2S$. Min. *Jalpaite.* As above.

Cuprocupric sodium sulphide, Cu_2S, CuS, Na_2S.

Scarcely decomp. by cold dil. HCl + Aq; conc. HCl + Aq decomp. easily on warming, without, however, dissolving all the Cu_2S. Completely decomp. by warm HNO_3 + Aq. (Schneider, Pogg. **138.** 315.)

Copper zinc sulphide, $CuS, 3ZnS$.

Copper sulphophosphide.

See **Copper phosphosulphide.**

Cupric telluride, $CuTe$.

Cu_2Te_3. Insol. in H_2O. (Parkmann, Sill. Am. J. (2) **3.** 335.)

Cu_2Te. (Brauner, M. **1889.** 423.)

Croceocobaltic bromide, $Co(NH_3)_4(NO_2)_2Br$.

Very sl. sol. in cold, easily in hot H_2O. (Gibbs, Proc. Am. Acad. **10.** 1.)

—— **chloraurate,** $2Co(NH_3)_4(NO_2)_2Cl, AuCl_3$.

Difficultly sol. in H_2O.

—— **chloride,** $Co(NH_3)_4(NO_2)_2Cl$.

Very sl. sol. in cold, easily in hot H_2O, but more sol. than the sulphate. (Gibbs.)

—— **chloroplatinate,** $2Co(NH_3)_4(NO_2)_2Cl, PtCl_4$.

Can be recrystallised without decomp. with difficulty. (Gibbs and Genth, Sill. Am. J. (2) **24.** 91.)

—— **chromate,** $[Co(NH_3)_4(NO_2)_2]_2CrO_4$.

Sl. sol. in H_2O. (Gibbs.)

—— ***di*chromate,** $[Co(NH_3)_4(NO_2)_2]_2Cr_2O_7$.

Sl. sol. in H_2O. (Gibbs.)

—— ***per*iodide,** $Co(NH_3)_4(NO_2)_2I, I_2$.

Difficultly sol. in cold H_2O and alcohol. Decomp. by hot H_2O. (Gibbs.)

Croceocobaltic nitrate, $Co(NH_3)_4(NO_2)_2NO_3$.

Sl. sol. in cold, easily sol. in hot H_2O or dil. acids. Much more sol. than the sulphate. (Gibbs.)

Sol. in about 400 pts. cold H_2O. (Jörgensen, Z. anorg. **5.** 163.)

—— **nitrite cobaltic nitrite,** $3Co(NH_3)_4(NO_2)_2, Co(NO_2)_3$.

Somewhat sol. in H_2O. (Jörgensen, Z. anorg. **5.** 178.)

—— **nitrite *di*amine cobaltic nitrite,** $Co(NH_3)_4(NO_2)_2, (NO_2)_2(NH_3)_2Co(NO_2)_2$.

Nearly insol. in cold, very sl. sol. in boiling H_2O. (Jörgensen.)

—— **phosphomolybdate,** $[Co(NH_3)_4(NO_2)_2]_2O, 24MoO_3, P_2O_5$.

Sl. sol. in cold, easily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 317.)

—— **sulphate,** $[Co(NH_3)_4(NO_2)_2]_2SO_4$.

Very sl. sol. in cold or hot H_2O; more easily in hot dil. H_2SO_4 + Aq.

Cuprammonium compounds.

See **Copper compounds, ammonia.**

Cupro*tetr*ammonium *tetra*iodide.

See **Cupric *tetra*iodide ammonia.**

Cupric acid.

Known only in solution. (Krüger, Pogg. **62.** 445.)

Calcium cuprate.

Decomp. by H_2O with evolution of oxygen. (Krüger and Crum, A. **55.** 213.)

Cyanhydric acid, HCN.

Miscible with H_2O, alcohol, and ether with absorption of heat.

Sp. gr. of HCN + Aq.

% HCN	Sp. gr.	% HCN	Sp. gr.
1·60	0·9979	4·0	0·9940
1·68	0·9978	4·6	0·9930
1·77	0·9975	5·0	0·9923
2·0	0·9974	5·3	0·9914
2·1	0·9973	5·8	0·9900
2·3	0·9970	6·4	0·9890
2·5	0·9967	7·3	0·9870
2·7	0·9964	8·0	0·9840
3·0	0·9958	9·1	0·9815
3·2	0·9952	10·6	0·9768
3·6	0·9945	16·0	0·9570

(Ure, Quar. J. Sci. **13.** 321.)

Miscible with volatile oils and other organic compounds.

2HCN mixed with $3H_2O$ causes a diminution of temp. of 9·75°. (Bussy and Buignet, A. ch. (4) **3.** 231.)

Cyanhydric iodhydric acid, HI, HCN.

Easily sol. in H_2O or alcohol, with rapid decomp. Sl. sol. in ether. (Gal, A. **138.** 38.)

Cyanides.

The alkali cyanides are easily sol. in H_2O; those of the alkali-earths are less sol., while all others are insol. with the exception of $Hg(CN)_2$. All cyanides are sol. in KCN+Aq.

Ammonium cyanide, NH_4CN.

Unstable; easily sol. in H_2O and alcohol.

Ammonium cuprous cyanide, NH_4CN, $Cu_2(CN)_2$.

Ppt. Decomp. by acids.

$2NH_4CN$, $Cu_2(CN)_2$. Sl. sol. in H_2O, but decomp. by long boiling therewith. Sol. in HCN+Aq. (Dufau, A. **88.** 278.)

Ammonium cuprous cyanide ammonia, NH_4CN, $Cu_2(CN)_2$, $3NH_3$.

Insol. in cold., sl. sol. in hot H_2O. (Fleurent, B. **25.** 103 R.)

NH_4CN, $2Cu_2(CN)_2$, $2NH_3+2H_2O$. (Fleurent, B. **25.** 498 R.)

Ammonium aurous cyanide, NH_4CN, $AuCN$.

Easily sol. in cold or warm H_2O or in alcohol. Insol. in ether.

Ammonium nickel cyanide, $2NH_4CN$, $Ni(CN)_2$.

Easily decomposed.

Ammonium zinc cyanide, $2NH_4CN$, $Zn(CN)_2$.

Sol. in H_2O.

Barium cyanide, $Ba(CN)_2$.

Rather sl. sol. in H_2O, more easily in KCN+Aq. (Schulz, J. pr. **68.** 257.)

10 pts. H_2O dissolve 8 pts., and 10 pts. 70 % alcohol dissolve 1·8 pts. $Ba(CN)_2$ at 14°. (Joannis, A. ch. (5) **26.** 489.)

$+2H_2O$. Very deliquescent.

$Ba(CN)_2$, BaO. (Drechsel, J. pr. (2) **21.** 84.)

Barium cadmium cyanide, $2Ba(CN)_2$, $3Cd(CN)_2+10H_2O$.

Sol. in H_2O. (Weselsky, B. **2.** 590.)

Barium cuprous cyanide, $Ba(CN)_2$, $Cu_2(CN)_2+H_2O$.

(Weselsky, B. **2.** 590.)

Barium aurous cyanide, $Ba(CN)_2$, $2AuCN+2H_2O$.

Sl. sol. in cold but easily sol. in hot H_2O. Sl. sol. in alcohol. (Lindbom, Lund Univ. Arsk. **12.** No. 6.)

Barium iridium cyanide.

See **Iridicyanide, barium.**

Barium manganous cyanide, $Ba(CN)_2$, $2Mn(CN)_2$.

Ppt. (Descamps.)

See also **Manganocyanide** *and* **Manganicyanide, barium.**

Barium palladium cyanide, $Ba(CN)_2$, $Pd(CN)_2+4H_2O$.

See **Palladocyanide, barium.**

Barium nickel cyanide, $Ba(CN)_2$, $Ni(CN)_2+3H_2O$.

Sol. in H_2O; decomp. by acids with pptn. of $Ni(CN)_2$. (Weselsky, B. **2.** 590.)

Barium silver cyanide, $Ba(CN)_2$, $2AgCN+H_2O$.

Sol. in H_2O. (Weselsky, B. **2.** 589.)

Barium zinc cyanide, $Ba(CN)_2$, $Zn(CN)_2+2H_2O$.

Sol. in H_2O.

Cadmium cyanide, $Cd(CN)_2$.

Sl. sol. in H_2O. 100 pts. H_2O dissolve 1·7 pts. $Cd(CN)_2$ at 15°. (Joannis.)

Easily sol. in acids; sol. in KCN+Aq. Sol. in warm NH_4OH+Aq, but insol. in $(NH_4)_2CO_3$+Aq. (Wittstein.)

$2Cd(CN)_2$, $CdO+5H_2O$. Insol. in H_2O. (Joannis.)

Cadmium cuprous cyanide, $2Cd(CN)_2$, $Cu_2(CN)_2$.

Permanent. Insol. in H_2O. Sl. sol. in cold, easily in warm HCl+Aq without decomp., except by long boiling. Insol. in NH_4OH, or NH_4 salts +Aq. (Schüler.)

Cadmium cupric cyanide, $Cd(CN)_2$, $Cu(CN)_2$.

Very unstable.

Cadmium aurous cyanide, $Cd(CN)_2$, $2AuCN$.

Nearly insol. in cold H_2O. Sl. sol. in boiling H_2O. Insol. in alcohol. (Lindbom.)

Cadmium mercuric cyanide, $2Cd(CN)_2$, $3Hg(CN)_2$.

Permanent. Readily sol. in cold H_2O. (Schüler.)

Cadmium mercuric cyanide mercuric iodide, $Cd(CN)_2$, $Hg(CN)_2$, HgI_2+8H_2O.

Very sol. in H_2O. (Varet, Bull. Soc. (3) **5.** 8.)

Cadmium mercuric cyanide mercuric iodide ammonia, $Cd(CN)_2$, $Hg(CN)_2$, HgI_2, $4NH_3$.

Very easily decomp. (Varet, Bull. Soc. (3) **6.** 22.)

Cadmium potassium cyanide, $Cd(CN)_2$, $2KCN$.

Sol. in 3 pts. cold, and 1 pt. boiling H_2O. Insol. in absolute alcohol. (Rammelsberg.)

Calcium cyanide, $Ca(CN)_2$.

Sol. in H_2O, but the solution is very unstable. (Schulz.)

$Ca(CN)_2$, $3CaO+15H_2O$. Decomp. by H_2O. (Joannis, A. ch. (5) **26.** 496.)

Calcium aurous cyanide, $Ca(CN)_2$, $2AuCN+3H_2O$.

Easily sol. in hot or cold H_2O or in alcohol. (Lindbom.)

Calcium manganous cyanide, $Ca(CN)_2$, $2Mn(CN)_2$.

Ppt. (Descamps.)

See also **Manganocyanide, calcium.**

Calcium nickel cyanide, $Ca(CN)_2$, $Ni(CN)_2+xH_2O$.

Sol. in H_2O.

Calcium zinc cyanide, $Ca(CN)_2$, $Zn(CN)_2+xH_2O$.

Sol. in H_2O. (Schindler, Mag. Pharm. **36.** 70.)

Cerous cyanide (?).

Ppt. Very easily decomp. (Behringer, A. **42.** 139.)

Chromic cyanide with MCN.

See **Chromicyanide, M.**

Chromous potassium cyanide.

See **Chromocyanide, potassium.**

Cobaltous cyanide, $Co(CN)_2+H_2O$.

Insol. in H_2O. Easily sol. in NH_4OH+Aq, and $KCN+Aq$; also in $(NH_4)_2CO_3$, or NH_4 succinate + Aq; insol. in NH_4NO_3, or NH_4Cl+Aq. (Wittstein.)

Cobaltous cyanide *with* **4MCN.**

See **Cobaltocyanide, M.**

Cobaltic cyanide *with* **3MCN.**

See **Cobalticyanide, M.**

Cobalt aurous cyanide, $Co(CN)_2$, $2AuCN$.

Insol. in H_2O or cold $HCl+Aq$.

Cuprous cyanide, $Cu_2(CN)_2$.

Insol. in H_2O and dil. acids. Sol. in NH_4OH, $(NH_4)_2SO_4$, or NH_4 succinate + Aq, and in hot NH_4Cl, or NH_4NO_3+Aq. Sol. in conc. $HCl+Aq$. Sol. in $KCN+Aq$.

Cupric cyanide, $Cu(CN)_2$ (?).

Easily decomp. Insol. in H_2O.

Cuprocupric cyanide, $Cu(CN)_2$, $Cu_2(CN)_2+5H_2O$.

Insol. in H_2O, but decomp. by boiling. Sol. in cold conc. $HCl+Aq$. Sol. in NH_4OH+Aq, $(NH_4)_2CO_3+Aq$, and in hot NH_4 salts + Aq. Easily sol. in $KCN+Aq$.

$+H_2O$. Ppt. (Dufau.)

$+Cu(CN)_2$, $2Cu_2(CN)_2+H_2O$. Ppt.

Cuprous mercuric cyanide mercuric bromide, $Cu_2(CN)_2$, $2Hg(CN)_2$, $HgBr_2$.

Sol. in H_2O. (Varet, Bull. Soc. (3) **4.** 384.)

Cuprous potassium cyanide, $Cu_2(CN)_2$, $KCN+H_2O$.

Insol. in H_2O. Sol. in acids with decomp.

$Cu_2(CN)_2$, $2KCN$. Sl. sol. in H_2O, with partial decomp. Decomp. by acids, but not by alkalies.

$3Cu_2(CN)_2$, $4KCN$. Sol. in H_2O.

$Cu_2(CN)_2$, $6KCN$. Sol. in H_2O.

Cuprous silver cyanide, $Cu_2(CN)_2$, $2AgCN$.

Ppt.

$Cu_2(CN)_2$, $6AgCN$. Sol. in excess of $Cu_2(CN)_2$, $KCN+Aq$. (Rammelsberg.)

Cuprocupric cyanide ammonia, $Cu(CN)_2$, $Cu_2(CN)_2$, $2NH_3+H_2O$.

Sl. sol. in cold, decomp. by boiling H_2O. Sol. in NH_4OH+Aq. (Dufau, A. **88.** 278.)

$Cu(CN)_2$, $Cu_2(CN)_2$ $3NH_3$. (Mills, Z. Ch. **1867.** 545.)

$Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3$. Insol. in cold, decomp. by hot H_2O. Sol. in NH_4OH, or $(NH_4)_2CO_3+Aq$.

$+2H_2O$.

$Cu(CN)_2$, $2Cu_2(CN)_2$, $2NH_3+H_2O$. (Monthier, J. Pharm. **11.** 257.)

$Cu(CN)_2$, $2Cu_2(CN)_2$, $4NH_3$. (Hilkenkamp, A. **97.** 218.)

$Cu(CN)_2$, $2Cu_2(CN)_2$, $6NH_3$. (Schiff and Becchi, A. **134.** 33.)

$2Cu(CN)_2$, $Cu_2(CN)_2$, $2NH_3+3H_2O$. (Fleurent, C. R. **114.** 1060.)

$2Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3+H_2O$. Correct formula for $Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3$. (Bouveault, Bull. Soc. (3) **4.** 641.)

Cuprous cyanide mercuric iodide, $Cu_2(CN)_2$, HgI_2.

Sol. in H_2O. (Varet, Bull. Soc. (3) **4.** 484.)

Aurous cyanide, $AuCN$.

Insol. in H_2O, alcohol, or ether. Not attacked by dil., or conc. acids, even boiling aqua regia.

Sol. in NH_4OH+Aq, also in soluble cyanides + Aq.

Slowly decomp. by boiling $KOH+Aq$, also by $(NH_4)_2S+Aq$.

Auric cyanide *with* **MCN.**

See **Auricyanide, M.**

Aurous potassium cyanide, $AuCN$, KCN.

Sol. in 7 pts. cold, and less than 0·5 pt. boiling H_2O. Sl. sol. in cold, and somewhat more sol. in boiling alcohol. Insol. in ether. (Himly, A. **42.** 160.)

Decomp. by warm acids, even tartaric, and acetic acids.

Aurous sodium cyanide, $AuCN$, $NaCN$.

Sl. sol. in cold, more easily in hot H_2O. Sl. sol. in alcohol. (Lindbom.)

Aurous strontium cyanide, $2AuCN$, $Sr(CN)_2+3H_2O$.

As the Na salt.

Aurous zinc cyanide, $2AuCN$, $Zn(CN)_2$.

Nearly insol. in hot or cold H_2O.

Insol. in cold $HCl+Aq$.

Iridium cyanide, $Ir(CN)_3$.

Insol. in H_2O. Sol. in $HCN+Aq$.

Iridium cyanide *with* **MCN.**

See **Iridicyanide, M.**

Lanthanum cyanide, $La(CN)_3$.

Ppt. (Frerichs and Smith, B. **11.** 910, 1151.)

Lead cyanide, $Pb(CN)_2$.

Sl. sol. in cold, more in hot H_2O. Sol. in HNO_3+Aq, and $KCN+Aq$. Partially sol. in NH_4OH+Aq, and NH_4 salts + Aq. Not pptd. in presence of Na citrate.

Above compound is $2PbO$, $Pb(CN)_2+H_2O$. (Joannis, A. ch. (5) **26.** 204.)

$2PbO$, $Pb(CN)_2+H_2O$. Insol. in H_2O.

Lead zinc cyanide, $Pb(CN)_2$, $2Zn(CN)_2$.

Ppt. (Rammelsberg.)

Lead cyanide chloride, $2Pb(CN)_2$, $PbCl_2$.

Insol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Lithium mercuric cyanide mercuric iodide, $2Li(CN)_2Hg(CN)_2$, HgI_2+7H_2O.

Deliquescent; sol. in H_2O. (Varet, C. R. **111.** 526.)

Magnesium cyanide, $Mg(CN)_2$.

Known only in aqueous solution which decomposes on evaporation. (Schulz.)

Magnesium mercuric cyanide mercuric bromide, $Mg(CN)_2$, $Hg(CN)_2$, $HgBr_2+8H_2O$.

Very sol. in H_2O. (Varet, Bull. Soc. (3) **7.** 170.)

Magnesium mercuric cyanide mercuric iodide, $Mg(CN)_2$, $Hg(CN)_2$, HgI_2+8H_2O.

Sol. in H_2O. (Varet, Bull. Soc. (3) **7.** 170.)

Manganous *and* **manganic cyanides.**

See **Manganocyanhydric,** *and* **Manganicyanhydric acids.**

Manganous strontium cyanide, $2Mn(CN)_2$, $Sr(CN)_2$.

Ppt. (Descamps.)

See also **Manganocyanide, strontium.**

Mercuric cyanide, basic, $Hg(CN)_2$, HgO.

Sl. sol. in cold, moderately sol. in hot H_2O. Sol. with decomp. in KOH, KCN, or KCl + Aq. (Johnston.)

Somewhat sol. in dil. alcohol.

$Hg(CN)_2$, $3HgO$. More sol. in H_2O than $Hg(CN)_2$, HgO.

$3Hg(CN)_2$, HgO. (Joannis, A. ch. (5) **26.** 469.)

Mercuric cyanide, $Hg(CN)_2$.

Moderately sol. in H_2O.

100 pts. $Hg(CN)_2$ + Aq sat. at 101·1° contain 35 pts. $Hg(CN)_2$, or 100 pts. H_2O dissolve 53·85 pts. $Hg(CN)_2$ at 101·1°. (Griffiths.)

Sol. in 8 pts. H_2O at 15°. (Abl.)

Sol. in 11 pts. cold, and 2·5 pts. boiling H_2O. (Wittstein.)

Not decomp. by acids except hot conc. H_2SO_4.

Sol. without decomp. in HNO_3 + Aq. (Berzelius.)

Sol. in KCN + Aq. Sol. in alkali chlorides + Aq.

Sol. in 20 pts. cold, and 5 pts. boiling alcohol. (Wittstein.)

Nearly insol. in absolute alcohol.

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 84.)

Mercuric potassium cyanide, $Hg(CN)_2$, $2KCN$.

Sol. in 4·4 pts. cold H_2O; sl. sol. in alcohol; decomp. by acids.

Mercuric silver cyanide, basic, $Hg(CN)_2$, HgO, $7AgCN$.

Ppt. (Bloxam, B. **16.** 2669.)

Mercuric silver cyanide mercuric sulphate, $Hg(CN)_2$, $2AgCN$, $HgSO_4+H_2O$.

Mercuric thallium cyanide, $Hg(CN)_2$, $2TlCN$.

Easily sol. in H_2O. 100 pts. H_2O dissolve 7·9 pts. at 1°, and 10·3 pts. at 10°. (Fronmüller, B. **11.** 92.)

Mercuric zinc cyanide, $4Zn(CN)_2$, $Hg(CN)_2$.

Insol. in H_2O. (Dunstan, Chem. Soc. **6.** 666.)

Mercuric cyanide ammonia, $2Hg(CN)_2$, $4NH_3+H_2O$.

Easily decomp. (Varet, Bull. Soc. (3) **6.** 221.)

$2Hg(CN)_2$, $2NH_3+H_2O$. Very sol. in NH_4OH + Aq or alcohol. (V.)

$Hg(CN)_2$, $2NH_3$. (V.)

Mercuric cyanide barium bromide, $2Hg(CN)_2$, $BaBr_2+6H_2O$.

Easily sol. especially in hot H_2O and alcohol.

Mercuric cyanide cadmium bromide, $Hg(CN)_2$, $CdBr_2+3H_2O$.

Sol. in H_2O and NH_4OH + Aq. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide cadmium bromide ammonia, $2Hg(CN)_2$, $CdBr_2$, $4NH_3$.

Efflorescent. Decomp. by H_2O.

Sl. sol. in NH_4OH + Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide calcium bromide, $2Hg(CN)_2$, $CaBr_2+5H_2O$.

Sol. in 1 pt. cold, and 0·25 pt. boiling H_2O; also in 2 pts. cold, and 1 pt. boiling 90 % alcohol. (Custer.)

Mercuric cyanide cupric bromide ammonia, $2Hg(CN)_2$, $CuBr_2$, $4NH_3$.

Decomp. by H_2O; sl. sol. in NH_4OH + Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide lithium bromide, $2Hg(CN)_2$, $2LiBr+7H_2O$.

Deliquescent. (Varet, C. R. **111.** 526.)

Mercuric cyanide magnesium bromide.

See **Magnesium mercuric cyanide mercuric bromide.**

Mercuric cyanide potassium bromide, $Hg(CN)_2$, $KBr+2H_2O$.

Sol. in 13·34 pts. H_2O at 18°, and less than 1 pt. boiling H_2O. (Brett.)

Sol. without decomp. in hot dil. H_2SO_4, HNO_3, or HCl + Aq. (Brett.)

Contains $1\frac{1}{2}H_2O$. (Berthelot, A. ch. (5) **29.** 226.)

Mercuric cyanide sodium bromide, $Hg(CN)_2$, $NaBr+1\frac{1}{2}H_2O$.

Sol. in H_2O and alcohol.

Mercuric cyanide strontium bromide, $2Hg(CN)_2$, $SrBr_2+6H_2O$.

Efflorescent. Sol. in H_2O and alcohol.

Mercuric cyanide zinc bromide, $HgBr_2$, $Hg(CN)_2$, $Zn(CN)_2+8H_2O$.

Sol. in H_2O and NH_4OH + Aq. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide zinc bromide ammonia, $HgBr_2$, $Hg(CN)_2$, $Zn(CN)_2$, $4NH_3$.

As the corresponding chloride. (Varet.)

Mercuric cyanide chloride, $Hg(CN)_2$, $HgCl_2$.

Sol. in H_2O. Decomp. by alcohol, which dissolves out $HgCl_2$.

Mercuric cyanide ammonium chloride, $Hg(CN)_2, NH_4Cl$.

Sol. in H_2O and alcohol. (Poggiale.)
$Hg(CN)_2, 4NH_4Cl$.

Mercuric cyanide barium chloride, $2Hg(CN)_2, BaCl_2 + 4H_2O$.

Efflorescent. Easily sol. in H_2O and alcohol.
$+6H_2O$. (Dexter.)

Mercuric cyanide barium chloride ammonia, $2Hg(CN)_2, BaCl_2, 4NH_3$.

Decomp. by H_2O. Sl. sol. in NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide cadmium chloride, $Hg(CN)_2, CdCl_2 + 2H_2O$.

Sol. in H_2O and NH_4OH+Aq. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide calcium chloride, $2Hg(CN)_2, CaCl_2 + 6H_2O$.

Efflorescent. Very sol. in H_2O.

Mercuric cyanide cerium chloride, $3Hg(CN)_2, CeCl_3 + 8H_2O$.

Very sol. in H_2O. (Ahlén, Bull. Soc. (2) **27.** 365.)

Mercuric cyanide cobaltous chloride, $Hg(CN)_2, 2CoCl_2 + 4H_2O$.

Sol. in H_2O. (Poggiale.)
$2Hg(CN)_2, CoCl_2 + 7H_2O$. (Dexter.)

Mercuric cyanide cupric chloride ammonia, $2Hg(CN)_2, CuCl_2, 4NH_3$.

Decomp. by H_2O. Sl. sol. in cold NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide didymium chloride, $3Hg(CN)_2, DiCl_3 + 8H_2O$.

Very sol. in H_2O. (Ahlén.)

Mercuric cyanide erbium chloride, $3Hg(CN)_2, ErCl_3 + 8H_2O$.

Easily sol. in H_2O. (Ahlén.)

Mercuric cyanide ferric chloride, $2Hg(CN)_2, FeCl_3 + 3\frac{1}{2}H_2O$.

(Dexter.)

Mercuric cyanide lanthanum chloride, $3Hg(CN)_2, LaCl_3 + 8H_2O$.

Very sol. in H_2O. (Ahlén.)

Mercuric cyanide magnesium chloride, $2Hg(CN)_2, MgCl_2 + 2H_2O$.

Easily sol. in H_2O and dil. alcohol. (Poggiale.)

Mercuric cyanide manganous chloride, $Hg(CN)_2, MnCl_2 + 3H_2O$.

Efflorescent. Very sol. in H_2O. (Poggiale.)

Mercuric cyanide nickel chloride, $Hg(CN)_2, NiCl_2 + 6H_2O$.

Deliquescent. Sol. in H_2O. (Poggiale.)
$2Hg(CN)_2, NiCl_2 + 7H_2O$. (Dexter.)

Mercuric cyanide potassium chloride, $Hg(CN)_2, KCl + H_2O$.

Sol. in 6·75 pts. H_2O at 18°. (Brett.)
Sol. in alcohol.

Mercuric cyanide sodium chloride, $Hg(CN)_2, NaCl$.

Easily sol. especially in hot H_2O; insol. in alcohol. (Poggiale.)

Mercuric cyanide strontium chloride, $2Hg(CN)_2, SrCl_2 + 6H_2O$.

Easily sol. in H_2O and dil. alcohol.

Mercuric cyanide yttrium chloride, $3Hg(CN)_2, YCl_3 + 8H_2O$.

Easily sol. in H_2O. (Ahlén, Bull. Soc. (2) **27.** 365.)

Mercuric cyanide zinc chloride, $2Hg(CN)_2, ZnCl_2 + 6H_2O$.

Efflorescent. Sol. in H_2O. (Kane.)
$HgCl_2, Hg(CN)_2, Zn(CN)_2 + 7H_2O$. Efflorescent. Very sol. in H_2O. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide zinc chloride ammonia, $HgCl_2, Hg(CN)_2, ZnCl_2, 4NH_3$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)
$Hg(CN)_2, Zn(CN)_2, HgCl_2, 6NH_3$. (Varet, C. R. **106.** 1080.)

Mercuric cyanide potassium chromate.

See **Chromate mercuric cyanide, potassium.**

Mercuric cyanide potassium ferrocyanide, $3Hg(CN)_2, K_4Fe(CN)_6 + 4H_2O$.

Readily sol. in H_2O.

Mercuric cyanide barium iodide, $2Hg(CN)_2, BaI_2 + 4H_2O$.

Slowly deliquescent. Sol. in 16·5 pts. cold, and 0·4 pt. boiling H_2O. Sol. in 22·5 pts. cold, and 1·6 pts. hot 90 % alcohol. Solution is decomp. on boiling. (Custer.)

Mercuric cyanide cadmium iodide, $Hg(CN)_2, Cd(CN)_2, HgI_2 + 8H_2O$.

See **Cadmium mercuric cyanide mercuric iodide.**

Mercuric cyanide calcium iodide, $2Hg(CN)_2, CaI_2 + 6H_2O$.

Sl. efflorescent. More sol. in H_2O than corresponding Sr comp. (Custer.)

Mercuric cyanide lithium iodide, $Hg(CN)_2, 2Li(CN)_2, HgI_2 + 7H_2O$.

See **Lithium mercuric cyanide mercuric iodide.**

Mercuric cyanide magnesium iodide, $Hg(CN)_2, Mg(CN)_2, HgI_2 + 8H_2O$.

See **Magnesium mercuric cyanide mercuric iodide.**

Mercuric cyanide potassium iodide, $Hg(CN)_2, KI$.

Sol. in 16 pts. cold, and less hot H_2O. Sol. in 96 pts. cold alcohol of 34° Baumé. (Caillot.) Sl. sol. in ether. Decomp. by acids.
$3Hg(CN)_2, 2KI + \frac{1}{2}H_2O$. (Berthelot.)

Mercuric cyanide sodium iodide, $Hg(CN)_2, NaI + 2H_2O$.

Sol. in $4\frac{1}{2}$ pts. H_2O at 18°, and $\frac{6}{7}$ pt. boiling H_2O.

Sol. in 2 pts. boiling, and $6\frac{1}{2}$ pts. cold 90 % alcohol. (Custer.)

Mercuric cyanide strontium iodide, $2Hg(CN)_2, SrI_2+6H_2O$.

Sol. in 7 pts. H_2O at 18°, and $\frac{1}{5}$ pt. at b.-pt. Sol. in 4 pts. 90 % alcohol at 18°, and $\frac{5}{6}$ pt. at b.-pt. (Custer.)

Mercuric cyanide zinc iodide, $2Hg(CN)_2, ZnI_2+6H_2O$.

Efflorescent ; sol. in H_2O.

Mercuric cyanide cadmium nitrate, $2Hg(CN)_2, Cd(NO_3)_2+7H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander, J. B. **1859.** 271.)

Mercuric cyanide cobalt nitrate, $2Hg(CN)_2, Co(NO_3)_2+7H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide copper nitrate, $Hg(CN)_2, Cu(NO_3)_2+5H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide ferrous nitrate, $2Hg(CN)_2, Fe(NO_3)_2+7H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide manganous nitrate, $Hg(CN)_2, Mn(NO_3)_2+5H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander.)

$2Hg(CN)_2, Mn(NO_3)_2+7H_2O$. As above.

Mercuric cyanide nickel nitrate, $2Hg(CN)_2, Ni(NO_3)_2+7H_2O$.

Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide silver nitrate, $2Hg(CN)_2, AgNO_3+2H_2O$.

Sl. sol. in cold, more readily in hot H_2O. Sol. with decomp. in HNO_3+Aq.

As sol. in alcohol as in H_2O.

Mercuric cyanide zinc nitrate, $2Hg(CN)_2, Zn(NO_3)_2+7H_2O$.

Sol. in H_2O with decomp. Not decomp. by alcohol. (Nylander, J. B. **1859.** 271.)

Mercuric cyanide potassium selenocyanide, $Hg(CN)_2, KSeCN$.

Sl. sol. in cold, much more easily sol. in hot H_2O or alcohol. Traces dissolve in ether. (Cameron and Davy, C. N. **44.** 63.)

Mercuric cyanide ammonium sulphocyanide, $Hg(CN)_2, NH_4SCN$.

Easily sol. in hot H_2O. (Cleve, Bull. Soc. (2) **23.** 71.)

Mercuric cyanide barium sulphocyanide, $2Hg(CN)_2, Ba(SCN)_2+4H_2O$.

Permanent. Sol. in hot H_2O. (Cleve.)

Mercuric cyanide cadmium sulphocyanide, $2Hg(CN)_2, Cd(SCN)_2+4H_2O$.

Permanent. Sol. in hot H_2O. (Cleve.)

Mercuric cyanide calcium sulphocyanide, $2Hg(CN)_2, Ca(SCN)_2+8H_2O$.

Sol. in H_2O. (Cleve.)

Mercuric cyanide cerium sulphocyanide, $3Hg(CN)_2, Ce(SCN)_3+12H_2O$.

Easily sol. in hot H_2O. (Jolin.)

Mercuric cyanide didymium sulphocyanide, $3Hg(CN)_2, Di(SCN)_3+6H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Cleve.)

Mercuric cyanide erbium sulphocyanide, $3Hg(CN)_2, 2Er(SCN)_3+12H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Cleve.)

Mercuric cyanide lanthanum sulphocyanide, $3Hg(CN)_2, La(SCN)_3+12H_2O$.

Very sol. in H_2O. (Cleve.)

Mercuric cyanide magnesium sulphocyanide, $2Hg(CN)_2, Mg(SCN)_2+4H_2O$.

Permanent. Easily sol. in hot H_2O. (Cleve.)

Mercuric cyanide potassium sulphocyanide, $Hg(CN)_2, KSCN$.

Permanent. Easily sol. in hot H_2O. (Cleve.)

$+2H_2O$. (Philip, Z. Ch. **1867.** 552.)

Mercuric cyanide samarium sulphocyanide, $3Hg(CN)_2, Sm(SCN)_3+12H_2O$.

Easily sol. in H_2O. (Cleve.)

Mercuric cyanide sodium sulphocyanide, $Hg(CN)_2, NaSCN+2H_2O$.

Efflorescent. Sol. in H_2O. (Cleve, Bull. Soc. (2) **23.** 71.)

Mercuric cyanide strontium sulphocyanide, $2Hg(CN)_2, Sr(SCN)_2+4H_2O$.

Efflorescent. (Cleve.)

Mercuric cyanide yttrium sulphocyanide, $3Hg(CN)_2, Y(SCN)_3+12H_2O$.

Sl. sol. in warm, much less in cold H_2O. (Cleve.)

Mercuric cyanide zinc sulphocyanide, $2Hg(CN)_2, Zn(SCN)_2+4H_2O$.

Sl. sol. in H_2O. (Cleve.)

Mercuric cyanide zinc sulphocyanide ammonia, $2Hg(CN)_2, Zn(SCN)_2, 3NH_3$.

Not efflorescent. Decomp. by H_2O.

Mercuric cyanide potassium thiosulphate, $Hg(CN)_2, K_2S_2O_3$.

Permanent. Sol. in H_2O. (Kessler.)

$+H_2O$. (Fock and Klüss, B. **24.** 1355.)

Nickel cyanide, $Ni(CN)_2+xH_2O$.

Insol. in H_2O. Insol. in conc. HCl, H_2SO_4, or HNO_3+Aq, but decomp. by heating therewith. Sol. in NH_4OH, warm $(NH_4)_2SO_4$, or NH_4 succinate+Aq ; also in KCN+Aq. Sl. sol. in NH_4Cl, or NH_4NO_3+Aq. (Wittstein.)

Nickel potassium cyanide, $Ni(CN)_2, 2KCN+H_2O$.

Sol. in H_2O. Decomp. by acids with residue of insol. $Ni(CN)_2$.

$+\frac{1}{2}H_2O$. (Rammelsberg.)

Nickel sodium cyanide, $Ni(CN)_2$, $2NaCN+3H_2O$.

Sol. in H_2O; decomp. by acids with residue of $Ni(CN)_2$.

Nickel strontium cyanide, $Ni(CN)_2$, $Sr(CN)_2+xH_2O$.

Sol. in H_2O. (Handl, J. B. **1859.** 273.)

Osmium cyanide, $Os(CN)_2$ (?).

Insol. in H_2O; not attacked by acids.

See also **Osmocyanhydric acid.**

Palladous cyanide, $Pd(CN)_2$.

Insol. in H_2O. Insol. in dil. acids. Sol. in KCN or NH_4OH+Aq, also in conc. $HCN+Aq$.

Platinous cyanide, $Pt(CN)_2$.

Insol. in H_2O, alkalies, or acids. Sol. in $KCN+Aq$. When freshly pptd. sol. in NH_4OH+Aq.

Platinous cyanide *with* **MCN.**

See **Platinocyanide, M.**

Potassium cyanide, KCN.

Deliquescent. Very sol. in H_2O.

100 pts. $KCN+Aq$, sat. at b.-pt. 103·3°, contain 55 pts. KCN, *i.e.* 100 pts. H_2O dissolve 122·2 pts. KCN at 103·3°. (Griffiths.)

$KCN+Aq$ containing 3·25 % KCN has sp. gr. = 1·0154; 6·5 % KCN, 1·0316. (Kohlrausch, W. Ann. **1879.** 1.)

Almost insol. in absolute alcohol.

Sol. in 80 pts. 95 % alcohol when boiling, and easily sol. in 35 % alcohol. (Geiger, A. **1.** 50.)

100 pts. absolute methyl alcohol dissolve 4·91 pts. at 19·5°; 100 pts. absolute ethyl alcohol dissolve 0·87 pt. at 19·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sol. in CS_2 when pure. (Loughlin, J. B. **1875.** 234.)

Wholly insol. in CS_2. (Moldenhauer, Z. anal. **16.** 199.)

Potassium silver cyanide, KCN, AgCN.

Sol. in 4·7 pts. H_2O at 15°, 4 pts. at 20°, and in much less at higher temp. Sol. in 25 pts. 85 % alcohol. (Baup, A. ch. (3) **53.** 464.)

Potassium silver sodium cyanide, 2KCN, NaCN, 3AgCN.

Sol. in 4·4 pts. H_2O at 15°, and 22 pts. 85 % alcohol at 17°. (Baup.)

Potassium zinc cyanide, 2KCN, $Zn(CN)_2$.

Easily sol. in cold H_2O.

Potassium cyanide sulphur *di***oxide,** KCN, SO_2+H_2O.

Much more sol. in hot than cold H_2O. (Étard, C. R. **88.** 649.)

KCN, HCN, $2SO_2+3H_2O$. Very sl. sol. in cold H_2O; decomp. by hot H_2O. (Étard.)

Rhodium cyanide, $Rh(CN)_3$.

Ppt. Not decomp. by acids. Sol. in $KCN+Aq$. (Martius, A. **117.** 361.)

Rhodium cyanide *with* **3KCN.**

See **Rhodicyanide, potassium.**

Ruthenium cyanide *with* **4MCN.**

See **Ruthenocyanide, M.**

Silver cyanide, AgCN.

Insol. in H_2O or dil. acids. Decomp. by conc. acids. Not sol. to any extent in $HCN+Aq$. Sol. in NH_4OH+Aq. Sol. in boiling KCl, NaCl, $CaCl_2$, $BaCl_2$, or $MgCl_2+Aq$, but very slowly sol. therein at ord. temp. Sol. in $Na_2S_2O_3$, $K_4Fe(CN)_6$, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, NH_4NO_3, and NH_4 succinate $+Aq$, and in large amt. of hot NH_4Cl+Aq. (Wittstein.)

Sol. in KCN, NaCN, $Ba(CN)_2$, $Ca(CN)_2$, or $Sr(CN)_2+Aq$. Insol. in KOH, or $NaOH+Aq$. Sol. in conc. boiling $AgNO_3+Aq$. (Wöhler.)

Sl. sol. in Na citrate $+Aq$.

Sol. in $Hg(NO_3)_2+Aq$.

Sol. in 431·7 pts. 5 % NH_4OH+Aq (sp. gr. 0·998) at 12°; in 184·5 pts. 10 % NH_4OH+Aq (sp. gr. 0·96) at 18°. (Longi, Gazz. ch. it. **13.** 87.)

Silver sodium cyanide, AgCN, NaCN.

Sol. in 5 pts. H_2O at 20° and in much less hot H_2O. Sol. in 24 pts. 85 % alcohol at 20°. (Baup, A. ch. (3) **53.** 468.)

Silver thallous cyanide, AgCN, TlCN.

Easily sol. in H_2O. 100 pts. H_2O dissolve 4·7 pts. at 0°, and 7·4 pts. at 16°. (Fronmüller, B. **11.** 92.)

Silver cyanide ammonia, AgCN, NH_3.

Efflorescent. Decomp. on air.

Silver cyanide nitrate, 2AgCN, $AgNO_3$.

Decomp. by H_2O.

Sodium cyanide, NaCN.

Sol. in H_2O and 75 % alcohol.

$+\frac{1}{2}H_2O$, and $2H_2O$. Very sol. in H_2O; sl. sol. in alcohol. (Joannis, A. ch. (5) **26.** 484.)

Sodium zinc cyanide, NaCN, $Zn(CN)_2+2\frac{1}{2}H_2O$.

Much more sol. in H_2O than the corresponding K Zn salt. (Rammelsberg.)

Strontium cyanide, $Sr(CN)_2+4H_2O$.

Very unstable; very deliquescent, and sol. in H_2O. (Joannis, A. ch. (5) **26.** 496.)

Thallous cyanide, TlCN.

100 pts. H_2O dissolve 16·8 pts. at 28·5°. (Fronmüller, B. **6.** 1178.)

Thallothallic cyanide, $Tl_2(CN)_4=TlCN$, $Tl(CN)_3$.

Easily sol. in H_2O.

100 pts. H_2O dissolve 27·3 pts. at 30°, 15·3 pts. at 12°, 9·7 pts. at 0°. (Fronmüller, B. **11.** 92.)

Thallous zinc cyanide, 2TlCN, $Zn(CN)_2$.

Easily sol. in H_2O. 100 pts. H_2O dissolve 8·7 pts. at 0°; 15·2 pts. at 14°; and 29·6 pts. at 31°. (Fronmüller, B. **11.** 92.)

Zinc cyanide, $Zn(CN)_2$.

Insol. in H_2O and alcohol. Sol. in alkalies. Easily sol. in $KCN+Aq$. Sol. in hot NH_4 salts $+Aq$. (Wittstein.)

Easily sol. in $(NH_4)_2CO_3+Aq$. (Gore.)

Sl. sol. in conc. Zn salts + Aq. 1 l. conc. $Zn(C_2H_3O_2)_2$ + Aq dissolves 4 g., and 1 l. conc. $ZnSO_4$ + Aq dissolves 2 g. $Zn(CN)_2$. Insol. in HCN + Aq. Easily sol. in dil. acids. (Joannis.)

Zinc cyanide ammonia, $Zn(CN)_2$, $2NH_3$.

Decomp. on air. (Varet, C. R. **105**. 1070.)

+ H_2O. Decomp. on air. Decomp. by H_2O. Sol. in NH_4OH + Aq. (Varet.)

Cyanogen, CN.

H_2O absorbs 4½ vols. CN gas at 20°. Alcohol absorbs 23 vols., and ether 5 vols. at the same temperature. (Gay-Lussac.)

The solution gradually decomposes, but this is prevented by traces of acids.

Oil of turpentine absorbs 5 vols. (Gay-Lussac.) Absorbed by many essential oils.

Very sol. in $CuCl_2$ + Aq.

Absorbed with decomp. by NH_4OH + Aq and other alkaline liquids.

Absorbed by aniline. (Jacquemain, C. R. **100**. 1006.)

Decamine cobaltic sulphite, $Co_2(NH_3)_{10}(SO_3)_3 + 3H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22**. 2636.)

Decamine cobaltisulphurous acid.

Cobaltic decamine cobaltisulphite, $Co_2(NH_3)_{10}(SO_3)_6Co_2 + 8H_2O$.

Ppt. (Vortmann and Magdeburg, B. **22**. 2635.)

Sodium decamine cobaltisulphite, $Co_2(NH_3)_{10}(SO_3Na)_6 + 2H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22**. 2635.)

Decipium, Dp.

Element has not been isolated.

Decipium hydroxide.

Insol. in caustic alkalies.

Decipium oxide, Dp_2O_3.

Easily sol. in dilute acids. (Delafontaine, C. R. **93**. 63.)

Diamide, N_2H_4.

See **Hydrazine.**

Diamine chromium sulphocyanhydric acid, $Cr(NH_3)_2(SCN)_3$, HSCN + H_2O.

Sol. in H_2O. (Nordenskiöld, Z. anorg. **1**. 130.)

Diamine chromium *di*aquo sulphocyanide, $Cr(NH_3)_2(SCN)_3 + 2H_2O$.

Sol. in H_2O, from which it is pptd. by conc. HCl + Aq. (Nordenskiöld, Z. anorg. **1**. 137.)

Ammonium diamine chromium sulphocyanide, $Cr(NH_3)_2(SCN)_3$, NH_4SCN.

(*Reinecke's salt.*) Quite easily sol. in H_2O, less in alcohol, and insol. in benzene. Slowly decomp. by boiling H_2O or dil. acids. (Nordenskiöld, Z. anorg. **1**. 130.)

+ H_2O. Insol. in absolute ether. (Christensen, J. pr. (2) **45**. 218.)

Ammonium diamine chromium sulphocyanide iodide, $Cr(NH_3)_2(SCN)_3$, NH_4SCN, I.

Barium —— —— ——, $[Cr(NH_3)_2(SCN)_3]_2$, $Ba(SCN)_2$.

Sol. in H_2O and alcohol. (N.)

Cadmium —— —— ——, $Cd(SCN)_2$, $[Cr(NH_3)_2(SCN)_3]_2 + H_2O$.

Nearly insol. in cold, sl. sol. in hot H_2O. Sl. sol. in boiling alcohol. (Christensen, J. pr. (2) **45**. 371.)

Cupric —— —— ——, $Cu(SCN)_2$, $[Cr(NH_3)_2(SCN)_3]_2$.

Insol. in H_2O or dil. acids. (Reinecke, A. **126**. 116.)

Ferric —— —— ——, $[Cr(NH_3)_2(SCN)_3]_3$, $Fe(SCN)_3$. (N.)

Luteocobaltic —— —— ——, $Co(NH_3)_6(SCN)_3[Cr(NH_3)_2(SCN)_3]_3$.

As good as insol. in cold H_2O. Sl. sol. in hot H_2O and alcohol. (Christensen, J. pr. (2) **45**. 370.)

Mercuric —— —— ——, $[Cr(NH_3)_2(SCN)_3]_2$, $Hg(SCN)_2$.

Insol. in H_2O. (N.)

Insol. in H_2O and dil. acids. (Reinecke.)

Potassium —— —— ——, $Cr(NH_3)_2(SCN)_3$, KSCN.

Properties as the NH_4 salt. (N.)

$Cr(NH_3)_2(SCN)_3$, KSCN, I. As the NH_4 salt. (N.)

Sodium —— —— ——, NaSCN, $Cr(NH_3)_2(SCN)_3$.

Sol. in H_2O, alcohol, and ether. (Reinecke.)

Diamine cobaltic nitrite ammonium nitrite, $Co(NH_3)_2(NO_2)_3$, NH_4NO_2.

Sol. in H_2O. (Erdmann.)

—— —— **nitrite lead nitrite,** $2Co(NH_3)_2(NO_2)_3$, $Pb(NO_2)_2$.

Sol. in hot H_2O with partial decomp.

—— —— **nitrite mercurous nitrite,** $2Co(NH_3)_2(NO_2)_3$, $Hg_2(NO_2)_2$.

Ppt. Not sol. in hot H_2O without decomp.

—— —— **nitrite potassium nitrite,** $Co(NH_3)_2(NO_2)_3$, KNO_2.

Sol. in H_2O. (Erdmann, J. pr. **97**. 385.)

—— —— **nitrite silver nitrite,** $Co(NH_3)_2(NO_2)_3$, $AgNO_2$.

Ppt. Crystallises out of hot H_2O. (Erdmann.)

—— —— **nitrite thallium nitrite,** $Co(NH_3)_2(NO_2)_3$, $TlNO_2$.

Crystallises out of hot H_2O without decomp.

Dichrocobaltic carbonate, $Co(NH_3)_3(OH)CO_3 + 1\frac{1}{2}H_2O$.

Sol. in H_2O. (Vortmann, B. **15**. 1901.)

Dichrocobaltic chloride, $Co(NH_3)_3Cl_3 + H_2O$.

Quite sol. in cold H_2O, dil. acids, conc. H_2SO_4, or dil. alcohol.

From solution in conc. H_2SO_4, the salt is precipitated by much HCl + Aq. Composition is $Co(NH_3)_3(OH_2)Cl_3$. (Jörgensen, Z. anorg. **5**. 189.)

—— **nitrate,** $Co(NH_3)_3(NO_3)_3 + 4H_2O$.

Deliquescent. Sol. in H_2O. More sol. in dil. HNO_3 + Aq than praseocobaltic nitrate. (Vortmann, B. **15**. 1897.)

Anhydrous. Insol. in H_2O as such, but converted into above salt thereby. (Jörgensen, Z. anorg. **5**. 186.)

—— **nitrite,** $Co(NH_3)_3(NO_2)_3$.

Difficultly sol. in cold, but rather easily sol. in hot H_2O.

—— **sulphate,** $[Co(NH_3)_3]_2(SO_4)_3 + 6H_2O$.

Easily sol. in H_2O. (Vortmann, B. **15**. 1900.)

—— **sulphite,** $[Co(NH_3)_3]_2(SO_3)_3 + H_2O$.

Nearly insol. in cold, slowly decomp. by hot H_2O. Decomp. by acids or KOH + Aq. Insol. in cold, sol. in warm NH_4OH + Aq. (Künzel, J. pr. (1) **72**. 209.) According to Geuther (A. **128**. 157), is a double salt—

$[Co(NH_3)_3]_2(SO_3)_3$, $Co_2(SO_3)_3 + 2H_2O$.

Didymium, Di.

Slowly decomp. by H_2O. Insol. in cold conc. H_2SO_4. Sol. in dil. acids.

Compound of two elements, neodidymium and praseodidymium. (v. Welsbach, W. A. B. **92**. 317.)

Didymium bromide, $DiBr_3 + 6H_2O$.

Very deliquescent, and sol. in H_2O. (Cleve.)

Didymium nickel bromide, $2DiBr_3$, $3NiBr_2 + 18H_2O$.

Deliquescent. Very sol. in H_2O. (Frerichs and Smith, A. **191**. 342.)

Didymium zinc bromide, $DiBr_3$, $3ZnBr_2 + 12H_2O$.

Extremely deliquescent. (Cleve, Bull. Soc. (2) **43**. 361.)

$2DiBr_3$, $3ZnBr_2 + 36H_2O$. (F. and S.)

Didymium chloride, $DiCl_3$.

Anhydrous. Deliquescent. Sol. in H_2O and alcohol. (Marignac.)

$+6H_2O$. Deliquescent. Easily sol. in H_2O and alcohol. (Marignac.)

Didymium mercuric chloride, $2DiCl_3$, $9HgCl_2 + 24H_2O$.

More sol. in H_2O than the corresponding La salt. (Marignac.)

$DiCl_3$, $4HgCl_2 + 11H_2O$. Not deliquescent. Easily sol. in H_2O.

Didymium stannic chloride.

See **Chlorostannate, didymium.**

Didymium fluoride, $DiF_3 + \frac{1}{2}H_2O$.

Precipitate. (Cleve.)

Didymium hydrogen fluoride, $2DiF_3$, 3HF.

Precipitate. (Smith.)

Does not exist. (Cleve.)

Didymium potassium fluoride, DiF_3, $KF + H_2O$.

Sol. in H_2O. (Brauner, B. **15**. 114.)

$+\frac{1}{3}H_2O$. As above. (B.)

$2DiF_3$, $3KF + H_2O$. As above. (B.)

Didymium hydroxide, $Di_2O_6H_6$.

Insol. in KOH, or NaOH + Aq, but is sl. sol. in NH_4Cl + Aq. (Rose.)

See also Di_2O_3.

Didymium *pent*hydroxide, $DiO_4H_3 = Di_2O_5$, $3H_2O$.

Precipitate. (Brauner, B. **15**. 113.)

Didymium zinc iodide, $2DiI_3$, $3ZnI_2 + 24H_2O$.

Very deliquescent. (Frerichs and Smith.)

Didymium oxide, Di_2O_3.

With H_2O slowly forms $Di_2O_6H_6$.

Sol. in conc., or dil. mineral acids (Marignac), and in acetic acid (Hermann). Sol. in ammonium salts + Aq.

Slightly more slowly sol. in conc. NH_4NO_3 + Aq than La_2O_3. (Damour and Deville.)

A solution of NH_4NO_3 in H_2O that can dissolve 2·9 mols. La_2O_3 dissolves 1 mol. Di_2O_3. (Brauner, B. **15**. 114.)

Didymium *per*oxide, Di_4O_9.

Sol. in acids with decomp. (Frerichs, B. **7**. 799.)

Not obtained by Cleve. (B. **11**. 910.)

The contradictory statements concerning the composition of Di peroxide are owing to the fact that praseodidymium is the only one of the constituents of Di which easily forms a peroxide. (v. Welsbach.)

Didymium *pent*oxide, Di_2O_5.

Sol. in dil. HNO_3, or H_2SO_4 + Aq in the cold without evolution of gas, but gas is evolved if treated with conc. acids. Insol. in HF + Aq. Sl. sol. in cold NH_4NO_3 + Aq. NH_4NO_3 + Aq that can dissolve 10 mols. Di_2O_3 and 29 mols. La_2O_3 dissolves only 1 mol. Di_2O_5. (Brauner, B. **15**. 111.)

$= Di_4O_9$. (Cleve.)

Didymium oxybromide, DiOBr.

(Frerichs and Smith.)

Didymium oxychloride, DiOCl.

Anhydrous. Insol. in H_2O. (Smith.)

$+3H_2O$. Sol. in cold dil. HNO_3 + Aq. (Marignac.) Sl. sol. in HCl + Aq. (Hermann.)

Didymium oxysulphide, Di_2O_2S.

Insol. in H_2O. Sol. in HCl + Aq without residue. (Marignac.)

Didymium sulphide, Di_2S_3.

Insol. in H_2O. Decomp. by dil. acids. (Marignac, A. ch. (3) **38**. 159.)

Disulphuric acid, $H_2S_2O_7$.

See ***Di*sulphuric acid.**

Dithionic acid (Hyposulphuric acid), $H_2S_2O_6$.

Known only in aqueous solution, which is stable only when dil. Can be evaporated in vacuo until sp. gr. = 1·347, but decomp. upon further evaporation. (Welter and Gay-Lussac, A. ch. **10**. 312.)

Dithionates.

All dithionates are sol. in H_2O.

Aluminum dithionate, $Al_2(S_2O_6)_3 + 18H_2O$.

Extremely deliquescent. Easily sol. in H_2O or absolute alcohol. (Klüss, A. **246**. 218.)

Aluminum ammonium dithionate, $Al_2(S_2O_6)_3, (NH_4)_2S_2O_6 + 27H_2O$.

Sl. deliquescent. Sol. in H_2O. (Klüss, A. **246**. 303.)

Ammonium dithionate, $(NH_4)_2S_2O_6$.

Very sol. in H_2O. Sol. in 0·79 pt. H_2O at 16°, with reduction of temp. Not decomp. on boiling. Insol. in absolute alcohol. (Heeren, Pogg. **7**. 172.)

Contains $\frac{1}{2}H_2O$. Sol. in 0·56 pt. H_2O at 19°. (Klüss, A. **246**. 194.)

Ammonium cadmium dithionate, $2(NH_4)_2S_2O_6, CdS_2O_6 + 4\frac{1}{2}H_2O$.

Sol. in H_2O. (Klüss, A. **246**. 298.)

Ammonium cobalt dithionate, $9(NH_4)_2S_2O_6, 2CoS_2O_6 + 16\frac{1}{2}H_2O$.

Sol. in H_2O. (Klüss.)

Ammonium cupric dithionate, $(NH_4)_2S_2O_6, 2CuS_2O_6 + 8H_2O$.

Sol. in H_2O.

Ammonium ferrous dithionate, $3(NH_4)_2S_2O_6, Fe_2S_2O_6 + 6H_2O$.

Sol. in H_2O. (Klüss, A. **246**. 300.)

$9(NH_4)_2S_2O_6, 2Fe_2S_2O_6 + 16\frac{1}{2}H_2O$. Sol. in H_2O. (Klüss.)

Ammonium manganous dithionate, $9(NH_4)_2S_2O_6, 2MnS_2O_6$.

Sol. in H_2O. (Klüss, A. **246**. 301.)

Ammonium nickel dithionate, $9(NH_4)_2S_2O_6, 2NiS_2O_6 + 16\frac{1}{2}H_2O$.

Sol. in H_2O. (Klüss.)

Ammonium zinc dithionate, $5(NH_4)_2S_2O_6, ZnS_2O_6 + 9H_2O$.

Easily sol. in H_2O. (Klüss, A. **246**. 296.)

$9(NH_4)_2S_2O_6, 2ZnS_2O_6 + 16\frac{1}{2}H_2O$. Easily sol. in H_2O. (Klüss.)

Ammonium dithionate chloride, $(NH_4)_2S_2O_6, NH_4Cl$.

Sol. in H_2O. (Fock and Klüss, B. **24**. 3017.)

Barium dithionate, $BaS_2O_6 + 2H_2O$.

Not efflorescent. Sol. in 7·17 pts. H_2O at 8°, 4·04 pts. at 18°, and 1·1 pts. H_2O at 100°. Insol. in alcohol. (Gay-Lussac, Heeren.)

Sol. in 0·994 pt. H_2O at 102°, the boiling-point of the sat. solution. (Baker, Bull. Soc. (2) **44**. 166.)

$+4H_2O$. Very efflorescent. (Heeren.)

Barium magnesium dithionate, $BaMg(S_2O_6)_2 + 4H_2O$.

Sol. in H_2O. (Schiff, A. **118**. 97.)

Barium rubidium dithionate, $BaRb_4(S_2O_6)_3 + H_2O$.

Sol. in H_2O. Solubility is diminished by presence of excess of Rb_2SO_4, but increased by BaS_2O_6. (Bodländer, Chem. Ztg. **14**. 1140.)

Barium sodium dithionate, $BaNa_4(S_2O_6)_2 + 4H_2O$.

Sol. in H_2O. Decomp. by recrystallisation. (Kraut, A. **118**. 95.)

$+6H_2O$. (Schiff.)

Barium dithionate chloride, $BaS_2O_6, BaCl_2 + 4H_2O$.

(Fock and Klüss, B. **23**. 3001.)

Bismuth dithionate, basic, $Bi_2O_3, S_2O_5 + 5H_2O$.

Efflorescent. Insol. in H_2O, but decomp. thereby into the following salt. Easily sol. in dil. acids, especially $HCl + Aq$. (Klüss, A. **246**. 183.)

$4Bi_2O_3, 3S_2O_5 + 5H_2O$. Insol. in H_2O. Sol. in dil. acids. (Klüss.)

Cadmium dithionate.

Deliquescent in moist air; very sol. in H_2O. (Heeren, Pogg. **7**. 183.)

Cadmium dithionate ammonia, $CdS_2O_6, 4NH_3$.

Decomp. by alcohol; sol. in $NH_4OH + Aq$, but decomp. on heating. (Rammelsberg, Pogg. **58**. 298.)

Calcium dithionate, $CaS_2O_6 + 4H_2O$.

Sol. in 2·46 pts. H_2O at 19°; 0·8 pt. at 100°. Insol. in alcohol. (Heeren, Pogg. **7**. 178.)

Cerous dithionate, $Ce_2(S_2O_6)_3 + 24H_2O$.

Very sol. in H_2O. (Jolin.)

+3, and $5H_2O$. (Wyrouboff.)

Chromic dithionate, $Cr_2(S_2O_6)_3 + 18H_2O$.

Sol. in H_2O and alcohol. (Klüss, A. **246**. 189.)

$3Cr_2O_3, 4S_2O_5 + 24H_2O$. Easily sol. in H_2O or alcohol. Insol. in ether. (Klüss.)

Cobaltous dithionate, $CoS_2O_6 + 6H_2O$.

Not deliquescent. Very sol. in H_2O. (Heeren.)

$+8H_2O$. Sol. in 0·49 pt. H_2O at 19°. Sol. in absolute alcohol. (Klüss, A. **246**. 203.)

Cupric dithionate, $CuS_2O_6 + 4H_2O$.

Not efflorescent. Very sol. in H_2O. Insol. in alcohol. (Heeren.)

$+5H_2O$. Efflorescent. Sol. in 0·64 pt. H_2O at 18·5°. (Klüss, A. **246**. 204.)

Cupric dithionate, basic, $4CuO, S_2O_5 + 4H_2O$.

Very sl. sol. in H_2O. (Heeren, Pogg. **7**. 181.)

Insol. in H_2O: easily sol. in dil. acids. (Klüss, A. **246**. 208.)

$+3H_2O$. Insol. in H_2O and in $NaC_2H_3O_2 + Aq$; sol. in traces in conc. $CuS_2O_6 + Aq$. Easily sol. in dil. acids, even $HC_2H_3O_2$, or $H_2S_2O_6 + Aq$. (Klüss.)

Cupric dithionate ammonia, CuS_2O_6, $4NH_3$.

Difficultly sol. in cold H_2O, moderately sol. in H_2O at 40°. Decomp. by much H_2O or by heating the solution above 60°. Decomp. by $HCl+Aq$. (Heeren.)

Didymium dithionate, $Di_2(S_2O_6)_3+24H_2O$.

Extremely sol. in H_2O. (Cleve.)

Erbium dithionate, $Er_2(S_2O_6)_3+18H_2O$.

Very sol. in H_2O or alcohol; insol. in ether. (Höglund.)

Glucinum dithionate, basic, $5GlO$, $2S_2O_5+14H_2O$.

Easily sol. in H_2O and absolute alcohol. (Klüss, A. **246.** 196.)

Ferrous dithionate, $FeS_2O_6+5H_2O$.

Very sol. in H_2O. Insol. in alcohol. Decomp. in aqueous solution into $FeSO_4$ by boiling. (Heeren, Pogg. **7.** 181.)

$+7H_2O$. Sol. in 0·59 pt. H_2O at 18·5°. (Klüss, A. **246.** 198.)

Ferric dithionate, basic, $8Fe_2O_3$, $S_2O_5+20H_2O$.

Insol. in H_2O or alcohol. Very sl. sol. in $H_2S_2O_6$ + Aq; easily sol. in HCl + Aq. (Heeren.)

Contains $14H_2O$. (Klüss, A. **246.** 200.)

$3Fe_2O_3$, $S_2O_5+8H_2O$. Insol. in H_2O. Easily sol. in acids. (Klüss, A. **246.** 201.)

Lanthanum dithionate, $La_2(S_2O_6)_3+16H_2O$, and $24H_2O$.

Sol. in H_2O. (Cleve.)

Lead dithionate, basic, $2PbO$, $S_2O_5+2H_2O$.

Very difficultly sol. in H_2O. (Heeren, Pogg. **7.** 171.)

$10PbO$, $S_2O_5+2H_2O$. Sl. sol. in H_2O. (Heeren.)

Lead dithionate, $PbS_2O_6+4H_2O$.

Easily sol. in H_2O. (Heeren.)

Sol. in 0·869 pt. H_2O at 20·5°. (Baker, C. N. **36.** 203.)

Lead strontium dithionate, $(Pb,Sr)S_2O_6+4H_2O$.

(Rammelsberg.)

Lithium dithionate, $Li_2S_2O_6+2H_2O$.

Sl. deliquescent, and easily sol. in H_2O. Insol. in alcohol. (Rammelsberg.)

Magnesium dithionate, $MgS_2O_6+6H_2O$.

Sol. in 0·85 pt. H_2O at 13°. Solution can be boiled without decomp. (Heeren, Pogg. **7.** 179.)

Sol. in 0·692 pt. H_2O at 17°. (Baker, C. N. **36.** 203.)

Manganous dithionate, $MnS_2O_6+3H_2O$.

Sol. in H_2O. (Kraut, A. **118.** 98.)

$+6H_2O$. Efflorescent. Sol. in H_2O. (Marignac, J. B. **1855.** 380.)

Mercurous dithionate, $Hg_2S_2O_6$.

Sl. sol. in cold, decomp. by hot H_2O. (Rammelsberg.)

Mercuric dithionate, basic, $5HgO$, $2S_2O_5$.

Sl. sol. in cold, decomp. by hot H_2O. Easily sol. in HNO_3+Aq. (Rammelsberg, Pogg. **59.** 472.)

Mercuric dithionate, $HgS_2O_6+6H_2O$.

Decomp. by H_2O or on standing. (Klüss, A. **246.** 216.)

Nickel dithionate, $NiS_2O_6+6H_2O$.

Sol. in H_2O. (Topsoë.)

Sol. in 0·897 pt. H_2O at 12°. (Baker, C. N. **36.** 203.)

Nickel dithionate ammonia, NiS_2O_6, $6NH_3$.

Can be recryst. from warm NH_4OH+Aq. Decomp. by H_2O. (Rammelsberg, Pogg. **58.** 295.)

Potassium dithionate, $K_2S_2O_6$.

Not deliquescent. Sol. in 16·5 pts. H_2O at 16°, and 1·58 pts. at 100°. Insol. in alcohol. (Heeren.)

Sol. in 2·65 pts. H_2O at 16°. (Dumas.)

Sol. in alcohol. (Dumas.)

Rubidium dithionate, $Rb_2S_2O_6$.

Sol. in H_2O. (Topsoë and Christiansen.)

Silver dithionate, $Ag_2S_2O_6+2H_2O$.

Sol. in 2 pts. H_2O at 16°. Sol. in NH_4OH+Aq. (Heeren, Pogg. **7.** 191.)

Silver sodium dithionate, $Ag_2S_2O_6$, $Na_2S_2O_6+4H_2O$.

Sol. in H_2O. (Kraut, A. **118.** 96.)

Silver dithionate ammonia, $Ag_2S_2O_6$, $4NH_3$.

Sol. in H_2O without decomp. (Rammelsberg, Pogg. **58.** 298.)

Sodium dithionate, $Na_2S_2O_6+2H_2O$.

Sol. in 2·1 pts. H_2O at 16°, and in 1·1 pts. boiling H_2O. Insol. in alcohol.

Fuming $HCl+Aq$ precipitates the salt from aqueous solution. (Heeren, Pogg. **7.** 76.)

$+6H_2O$. (Kraut, A. **117.** 97.)

Strontium dithionate, $SrS_2O_6+4H_2O$.

Sol. in 4·5 pts. H_2O at 16°, 1·5 pts. boiling H_2O. Insol. in alcohol. (Heeren, Pogg. **7.** 177.)

Thallous dithionate, $Tl_2S_2O_6$.

Very easily sol. in H_2O. (Werther.)

Thallous dithionate sulphate, $3Tl_2S_2O_6$, Tl_2SO_4.

Sol. in H_2O. (Wyrouboff, Ann. Phys. Beibl. **8.** 802.)

Thorium dithionate, $Th(S_2O_6)_2+4H_2O$ (?).

Very unstable. (Klüss, A. **246.** 188.)

Stannous dithionate, SnS_2O_6.

Known only in solution.

$8SnO$, $S_2O_5+9H_2O$. Insol. in H_2O. Sol. in dil. acids, even dithionic acid +Aq. (Klüss, A. **246.** 186.)

Uranous dithionate, $6UO_2$, $S_2O_5+10H_2O$.

Insol. in H_2O; sol. in warm $HCl+Aq$. (Klüss, A. **246.** 191.)

$7UO_2$, $S_2O_5+8H_2O$. As above.

$8UO_2$, $S_2O_5+21H_2O$. As above.

***Di*vanadyl dithionate,** $(VO_2)_2S_2O_6$.

Sol. in H_2O. (Bevan, C. N. **38.** 294.)

Yttrium dithionate, $Y_2(S_2O_6)_3 + 18H_2O$.

Not deliquescent. Easily sol. in H_2O, but difficultly sol. in alcohol. Insol. in ether. (Cleve, Bull. Soc. (2) **21**. 344.)

Zinc dithionate, $ZnS_2O_6 + 6H_2O$.

Very sol. in H_2O; decomp. on boiling. (Heeren, Pogg. **7**. 183.)

Zinc dithionate ammonia, $ZnS_2O_6, 4NH_3$.

Decomp. with H_2O; sol. in warm, less sol. in cold NH_4OH+Aq. (Rammelsberg, Pogg. **58**. 297.)

Dysprosium, Dy (?).

(Lecoq de Boisbaudran, C. R. **102**. 1005.)

Erbium, Er.

Decomposes H_2O. (Höglund.)
Probably has not been isolated.
The so-called element "erbium" can be further decomp. into simple substances. (Krüss, Z. anorg. **3**. 353.)

Erbium bromide, $ErBr_3 + 9H_2O$.

Very deliquescent.

Erbium chloride, $ErCl_3 + 6H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Höglund.)

Erbium mercuric chloride, $ErCl_3, 5HgCl_2 + xH_2O$.

Deliquescent. (Cleve.)

Erbium fluoride, ErF_3.

Insol. in H_2O. Very sl. sol. in HF+Aq. (Höglund, Bull. Soc. (2) **18**. 193.)

Erbium hydroxide, $Er_2O(OH)_4$.

Insol. in KOH, or NaOH+Aq.
Easily sol. in acids. Decomp. ammonium salts by boiling therewith.

Erbium iodide, ErI_3.

Very deliquescent. Very sol. in H_2O and alcohol. Insol. in ether. (Höglund.)

Erbium oxide, Er_2O_3.

Difficultly but completely sol. in warm HNO_3, H_2SO_4, or HCl+Aq. Decomp. NH_4 salts by boiling therewith.

Erbium *per*oxide, Er_2O_5.

Precipitate. (Cleve, Bull. Soc. (2) **43**. 53.)

Erbium sulphide.

Decomp. in moist air and with acids.

Erythrochromium bromide,

$HOCr_2(NH_3)_{10}Br_5 + H_2O$.

Very easily sol. in H_2O. Insol. in HBr+Aq. Sol. in NH_4OH+Aq. (Jörgensen, J. pr. (2) **25**. 398.)

—— **bromide, basic,** $HOCr_2(NH_3)_{10}(OH)Br_4 + H_2O$.

Very sol. in H_2O. (Jörgensen.)

—— **chloroiodide,** $HOCr_2(NH_3)_{10}ClI_4 + H_2O$.

Sol. in H_2O and in alcohol. (Jörgensen.)

—— **chloroplatinate,** $[HOCr_2(NH_3)_{10}]_2(PtCl_6)_5 + 10H_2O$.

Nearly insol. in H_2O. (Jörgensen.)

Erythrochromium dithionate, basic, $HOCr_2(NH_3)_{10}(S_2O_6)_2(OH) + 2H_2O$.

Insol. in H_2O. Easily sol. in very dil. HNO_3, HBr, HCl+Aq. Sol. in conc. NH_4Cl+Aq. (Jörgensen.)

—— **nitrate,** $HOCr_2(NH_3)_{10}(NO_3)_5 + H_2O$.

Easily sol. in H_2O. Insol. in dil. HNO_3+Aq. Sol. in conc. HNO_3 with decomp. Very sol. in dil. NH_4OH+Aq. Insol. in alcohol. (Jörgensen.)

—— **nitrate, basic,** $HOCr_2(NH_3)_{10}(NO_3)_4OH + 3\frac{1}{2}H_2O$.

Sol. in cold H_2O. (Jörgensen.)

—— **sulphate,** $[HOCr_2(NH_3)_{10}]_2(SO_4)_5$.

Nearly insol. in H_2O. (Jörgensen.)

*Tetra*ferriammonium, Fe_2N.

See **Iron nitride.**

Ferric acid.

Barium ferrate, $BaFeO_4 + H_2O$.

Ppt. Can be boiled for some time with H_2O without decomp. Decomp. by mineral acids. Sol. in dil. acetic acid. (Fremy, A. ch. (3) **12**. 373.)

Potassium ferrate, K_2FeO_4.

Very deliquescent. Easily sol. in cold H_2O with evolution of much heat. Decomp. by standing or warming. Decomp. by acids or alkalies. (Fremy, A. ch. (3) **12**. 369.)

Quickly decomp. by potassium tartrate or racemate, sugar, or albumen without separation of $Fe_2O_6H_6$, by alcohol with separation of $Fe_2O_6H_6$. Potassium oxalate, acetate, formate, and benzoate, also citrate decomp. much more slowly. Insol. in conc. KOH+Aq. (Wackenroder, A. **33**. 41.)

Sodium ferrate, Na_2FeO_4.

Sol. in H_2O and in conc. NaOH+Aq. (Fremy, *l.c.*)

Ferricyanhydric acid,

$H_3Fe(CN)_6$, (or $H_6Fe_2(CN)_{12}$).

Easily sol. in H_2O or alcohol. Solution decomposes slowly by standing, more rapidly by heating. Insol. in ether.

Ferricyanides.

The alkali, and alkaline-earth ferricyanides are sol. in H_2O; the others are insol. The ferricyanides of metals, the oxides of which are sol. in NH_4OH, or KOH+Aq, are themselves sol. in those reagents.

Ammonium ferricyanide, $(NH_4)_3Fe(CN)_6 + 3H_2O$.

Permanent. Readily sol. in H_2O (and alcohol ?).

Ammonium ferrous ferricyanide, $NH_4FeFe(CN)_6 + 1\frac{1}{2}H_2O$.

Sol. in H_2O and not pptd. by alcohol from aqueous solution. More stable than the corresponding K salt.

Ammonium lead ferricyanide, $NH_4PbFe(CN)_6 + 3H_2O$.

Ammonium potassium ferricyanide, $(NH_4)_2KFe(CN)_6$.

Sol. in H_2O. (Schaller, Bull. Soc. (2) **1.** 275.)

Barium ferricyanide, $Ba_3[Fe(CN)_6]_2 + 20H_2O$.

Easily sol. in H_2O; insol. in alcohol. (Schuler, W. A. B. **77.** 692.)

Barium potassium ferricyanide, $BaKFe(CN)_6 + 3H_2O$.

Permanent. Easily sol. in H_2O, less in alcohol.

Barium ferricyanide, $Ba_3[Fe(CN)_6]_2, 2BaBr_2 + 20H_2O$.

Easily sol. in H_2O. Boiling alcohol does not dissolve out $BaBr_2$. (Rammelsberg, J. pr. (2) **39.** 463.)

Bismuth ferricyanide, $Bi_3[Fe(CN)_6]_5$.

Insol. in H_2O, but decomp. by boiling therewith. (Muir, Chem. Soc. **32.** 40.)

Cadmium ferricyanide ammonia, $Cd_3[Fe(CN)_6]_2, 6NH_3 + 3H_2O$.

Effloresces to form—

$Cd_3[Fe(CN)_6]_2, 4NH_3 + 2H_2O$. Insol. in H_2O. (Wyrouboff, A. ch. (5) **10.** 413.)

Calcium ferricyanide, $Ca_3[Fe(CN)_6]_2 + 10$, or $12H_2O$.

Deliquescent. Sol. in H_2O and dil. alcohol.

Calcium potassium ferricyanide, $CaKFe(CN)_6$.

Sol. in H_2O.

Cerous ferricyanide, $CeFe(CN)_6 + 4H_2O$.

Sol. in H_2O; easily decomp. (Jolin.)

Chromic ferricyanide (?).

Ppt.

Cobaltous ferricyanide, $Co_3[Fe(CN)_6]_2$.

Insol. in H_2O and HCl+Aq. Sol. in NH_4OH+Aq.

Cobaltous ferricyanide ammonia, $Co_3[Fe(CN)_6]_2, 4NH_3 + 6H_2O$.

Cobaltic ferricyanide ammonia.

See **Luteo-, purpureo-, etc. cobaltic ferricyanide.**

Cuprous ferricyanide, $(Cu_2)_3[Fe(CN)_6]_2$.

Sol. in NH_4OH+Aq; insol. in NH_4 salts+Aq. (Wittstein.)

Cupric ferricyanide, $Cu_3[Fe(CN)_6]_2$.

Insol. in H_2O or NH_4 salts+Aq. Sol. in NH_4OH, and $(NH_4)_2CO_3$+Aq. (Wittstein.)

Insol. in HCl+Aq.

Ferrous ferricyanide, $Fe_3[Fe(CN)_6]_2 + xH_2O$.

(*Turnbull's blue.*) Properties as ferric ferrocyanide (Prussian blue), with which it is perhaps identical. (Gintl, Z. anal. **21.** 110.)

Ferrosoferric ferricyanide, $Fe_{13}(CN)_{36} = Fe^{'''}_4Fe^{''}_3[Fe(CN)_6]_6$.

(*Prussian green.*) Insol. in H_2O or conc. HCl+Aq, but slowly decomp. by boiling therewith.

$Fe_3(CN)_8 + 4H_2O = Fe^{''}_3Fe^{'''}_2[Fe(CN)_6]_4 + 12H_2O$. Properties as above. (Reynolds, Chem. Soc. **54.** 767.)

Ferrous potassium ferricyanide, $KFe_2(CN)_6 = KFeFe(CN)_6 + 4$ or $3H_2O$.

(*Soluble Prussian blue.*) Sol. in H_2O, but insol. in salts+Aq or alcohol.

Salt of the same composition, called "Williamson's blue," is insol. in H_2O.

Lead ferricyanide, basic, $Pb_3[Fe(CN)_6]_2, 3PbO_2H_2 + 11H_2O$.

(Schuler.)

Lead ferricyanide, $Pb_3[Fe(CN)_6]_2 + 16H_2O$.

Sl. sol. in H_2O; more sol. in hot, than cold H_2O, but decomp. on boiling. (Gmelin.)

$+4H_2O$. Easily sol. in H_2O; sl. sol. in alcohol. (Schuler, W. A. B. **77.** 692.)

Lead potassium ferricyanide, $PbKFe(CN)_6 + 3H_2O$.

Sol. in 4·75 pts. H_2O at 16°, and the solution decomp. on standing. (Schuler.)

$+1\frac{1}{2}H_2O$. Efflorescent. Much more sol. in H_2O than the Pb salt. Insol. in alcohol. (Wyrouboff.)

Lead ferricyanide nitrate, $Pb_3[Fe(CN)_6]_2, Pb(NO_3)_2 + 12H_2O$.

Sol. in 13·31 pts. H_2O at 16°. (Schuler.)

$+11H_2O$. (Joannis, A. ch. (5) **26.** 528.)

Magnesium ferricyanide, $Mg_3[Fe(CN)_6]_2$.

Sol. in H_2O.

Magnesium potassium ferricyanide, $MgKFe(CN)_6$.

(Reindel, J. pr. **103.** 166.)

Manganous ferricyanide, $Mn_3[Fe(CN)_6]_2$.

Insol. in H_2O, acids, NH_4OH, or NH_4 salts+Aq.

Nickel ferricyanide ammonia, $Ni_3[Fe(CN)_6]_2, 4NH_3 + H_2O$.

Sol. in NH_4OH+Aq. (Reynoso, A. ch. (3) **30.** 254.)

Nickel ferricyanide, $Ni_3[Fe(CN)_6]_2$ (?).

Ppt. Insol. in HCl+Aq.

Potassium ferricyanide, $K_3Fe(CN)_6$, (or $K_6Fe_2(CN)_{12}$).

Permanent. Easily sol. in H_2O.

100 pts. H_2O dissolve pts. $K_3Fe(CN)_6$ at t°.

t°	Pts. salt	t°	Pts. salt	t°	Pts. salt
4·4	33·0	15·6	40·8	100	77·5
10	36·6	37·8	58·8	104·4	82·6

(Wallace, Chem. Soc. **7.** 80.)

100 pts. H_2O at 13° dissolve 38 pts., and the solution has sp. gr. = 1·1630. (Schiff, A. **113.** 350.)

Sp. gr. of $K_3Fe(CN)_6+Aq$ at 13°.

% salt	Sp. gr.	% salt	Sp. gr.	% salt	Sp. gr.
1	1·0051	11	1·0595	21	1·1202
2	1·0103	12	1·0653	22	1·1266
3	1·0155	13	1·0712	23	1·1331
4	1·0208	14	1·0771	24	1·1396
5	1·0261	15	1·0831	25	1·1462
6	1·0315	16	1·0891	26	1·1529
7	1·0370	17	1·0952	27	1·1596
8	1·0426	18	1·1014	28	1·1664
9	1·0482	19	1·1076	29	1·1732
10	1·0538	20	1·1039	30	1·1802

(Schiff.)

Sat. $K_3Fe(CN)_6+Aq$ boils at 104·4°. (Wallace.)

Insol. in absolute alcohol, and only sl. sol. in dil. alcohol.

Potassium sodium ferricyanide, $KNa_2Fe(CN)_6$.

Sol. in H_2O.

$K_2NaFe(CN)_6$. Sol. in H_2O.

$K_3Na_3[Fe(CN)_6]_2$. Sol. in H_2O.

$+3H_2O$.

Potassium ferricyanide iodide, $K_3Fe(CN)_6$, KI.

Very unstable.

Silver ferricyanide, $Ag_3Fe(CN)_6$.

Sol. in NH_4OH, and hot $(NH_4)_2CO_3+Aq$, but insol. in NH_4 salts+Aq.

Insol. in $Hg(NO_3)_2+Aq$. (Wackenroder, A. **41.** 317.)

Silver ferricyanide ammonia, $2Ag_3Fe(CN)_6$, $3NH_3+\frac{1}{2}H_2O$.

Insol. in H_2O. Sol. in NH_4OH+Aq. (Gintl.)

Sodium ferricyanide, $Na_3Fe(CN)_6+H_2O$.

Deliquescent. Sol. in 5·3 pts. cold, and 1·5 pts. boiling H_2O. Insol. in alcohol, but not pptd. thereby from aqueous solution. (Bette.)

Ferrinitrososulphydric acid.

See **Ferro*heptа*nitrososulphydric acid.**

Ferrocyanhydric acid, $H_4Fe(CN)_6$.

Sol. in H_2O and alcohol.

100 pts. H_2O dissolve 15 pts. acid at 14°. (Joannis, A. ch. (5) **26.** 514.)

Insol. in ether, and much less sol. in ether-alcohol than in alcohol. Insol. in conc. HCl+Aq.

Ferrocyanides.

The ferrocyanides of the alkali and alkaline-earth metals are sol. in H_2O; the others are insol., but sol. in alkalies+Aq in case the base is sol. therein.

Aluminum ferrocyanide, $Al_4[Fe(CN)_6]_3+17H_2O$.

Sl. sol. in H_2O.

Sl. sol. in HCl+Aq with partial decomp. (Wyrouboff, A. ch. (5) **8.** 446.)

Ammonium ferrocyanide, $(NH_4)_4Fe(CN)_6+3H_2O$.

Very sol. in H_2O; insol. in alcohol.

$+H_2O$. (Berzelius.)

Ammonium cadmium ferrocyanide ammonia, $(NH_4)_2Cd_3[Fe(CN)_6]_2$, $2NH_3+H_2O$.

Sol. in H_2O. (Wyrouboff, A. ch. (5) **10.** 413.)

Ammonium calcium ferrocyanide, $(NH_4)_2CaFe(CN)_6$.

Sl. sol. in H_2O. (Kunheim and Zimmerman, Dingl. **252.** 478.)

Ammonium cupric ferrocyanide, $(NH_4)_2CuFe(CN)_6$.

Ppt.

Ammonium lithium ferrocyanide, $(NH_4)_2Li_2Fe(CN)_6+3H_2O$.

Sol. in H_2O. (Wyrouboff, A. ch. (4) **21.** 270.)

Ammonium manganous ferrocyanide, $NH_4MnFe(CN)_6$.

Ppt. (Blum, Z. anal. **30.** 284.)

Ammonium potassium ferrocyanide, $NH_4K_3Fe(CN)_6+3H_2O$.

Easily sol. in cold, more easily in hot H_2O. Insol. in alcohol.

$(NH_4)_2K_2Fe(CN)_6+3H_2O$. Sol. in H_2O.

$(NH_4)_3KFe(CN)_6$, $2NH_4Cl$. Sol. in H_2O. (Étard, J. pr. (2) **31.** 430.)

Ammonium ferrocyanide bromide, $(NH_4)_4Fe(CN)_6$, $2NH_4Br$.

Permanent. Very sol. in H_2O.

Ammonium ferrocyanide chloride, $(NH_4)_4Fe(CN)_6$, $2NH_4Cl+3H_2O$.

Permanent. Very sol. in H_2O, but less so than NH_4Cl. (Bunsen.)

Antimony ferrocyanide, $Sb_4[Fe(CN)_6]_3+25H_2O$.

Ppt. (Atterberg.)

Barium ferrocyanide, $Ba_2Fe(CN)_6+6H_2O$.

Permanent. Sl. sol. in H_2O.

Sol. in 584 pts. cold, and 116 pts. boiling H_2O (Duflos, **1832**); sol. in 1800 pts. cold H_2O (Porrett, **1814**); sol. in 1920 pts. cold, and about 100 pts. boiling H_2O (Thomson); sol. in 2000 pts. cold, and 100 pts. boiling H_2O. (Ure's Dict.)

Sol. in 1000 pts. H_2O at 15°, and 100 pts. at 75°. (Wyrouboff, A. ch. (4) **16.** 292.)

Sol. in HNO_3, HCl, or conc. H_2SO_4+Aq.

Barium potassium ferrocyanide, $BaK_2Fe(CN)_6+3H_2O$.

Sol. in 38 pts. cold, and 9·5 pts. boiling H_2O (Duflos, **1832**); in 36·4 pts. H_2O at 14°, and 11·9 pts. at b.-pt. (Mosander.)

Not more sol. in NH_4Cl+Aq than in H_2O. Sol. in dil., insol. in conc. HCl+Aq. (Rose.)

$+5H_2O$. Sol. in 300 pts. H_2O at ord. temp. (Wyrouboff.)

Bismuth ferrocyanide, $Bi_2Fe(CN)_6+5H_2O$ (?).

Sl. sol. in pure H_2O. (Wyrouboff.)

$Bi_4[Fe(CN)_6]_5$. Ppt. (Muir, Chem. Soc. **31.** 657.)

Bismuth potassium ferrocyanide, $BiKFe(CN)_6+7H_2O$, or $4H_2O$.

Ppt.

Cadmium potassium ferrocyanide, $CdK_2Fe(CN)_6+H_2O$.

Insol. in H_2O.

Formula given by Wyrouboff is $Cd_5K_6[Fe(CN)_6]_4+11H_2O$ (?).

Calcium ferrocyanide, $Ca_2Fe(CN)_6+12H_2O$.

Very sol. in H_2O. Sol. in 0·66 pt. H_2O at 90° and not pptd. by cooling, and is apparently less sol. in warm than cold H_2O. (Wyrouboff, A. ch. (4) **16.** 280.)

Calcium potassium ferrocyanide, $CaK_2Fe(CN)_6$.

Sl. sol. in H_2O. (Kunheim and Zimmerman, Dingl. **252.** 478.)

$+3H_2O$. Sol. in 795 pts. H_2O at 15°, and 145 pts. at b.-pt., with decomp. in the latter case.

Sol. in dil., insol. in conc. $HCl+Aq$. Sol. in HNO_3 of 1·2 sp. gr. (Mosander.)

Insol. in NH_4Cl+Aq.

Calcium sodium ferrocyanide, $CaNa_6[Fe(CN)_6]_2$.

Sol. in H_2O.

Calcium strontium ferrocyanide, $CaSrFe(CN)_6+10H_2O$.

Efflorescent. Sol. in about 3 pts. H_2O. (Wyrouboff, A. ch. (4) **21.** 278.)

Cerium ferrocyanide, $Ce_4[Fe(CN)_6]_3+30H_2O$.

Ppt. (Wyrouboff.)

Cerium potassium ferrocyanide, $CeKFe(CN)_6+3H_2O$.

Ppt. (Jolin.)

$+4H_2O$. (Wyrouboff.)

Chromic ferrocyanide, $Cr_2[Fe(CN)_6]_3+20H_2O$.

Ppt.

Cobaltous ferrocyanide, $Co_2Fe(CN)_6+7H_2O$.

Wholly insol. in H_2O.

Sol. in H_2SO_4 with decomp. Insol. in $HCl+Aq$. Sl. sol. in NH_4OH+Aq. Sol. in $(NH_4)_2CO_3+Aq$. Insol. in NH_4Cl+Aq. Sol. in $KCN+Aq$.

Cobaltous ferrocyanide ammonia, $Co_2Fe(CN)_6$, $8NH_3+10H_2O$.

Ppt. Decomp. on standing. (Curda, Z. Ch. **1869.** 369.)

$Co_2Fe(CN)_6$, $12NH_3+9H_2O$. As above. (Curda.)

Cobaltous potassium ferrocyanide, $CoK_2Fe(CN)_6$.

Ppt. (Wyrouboff.)

$Co_5K_8[Fe(CN)_6]_4$ (?). Ppt. Insol. only in presence of an excess of $K_4Fe(CN)_6$. (Wyrouboff.)

Columbium potassium ferrocyanide, $Cb_{16}K[Fe(CN)_6]_2+67H_2O$ (?).

Sol. in H_2O. (Wyrouboff.)

$Cb_{12}K_2Fe(CN)_6+39H_2O$ (?). Sol. in H_2O. (W.)

$(CbO)_5K_9[Fe(CN)_6]_6+10H_2O$ (?). Ppt. (Atterberg.)

Cuprous ferrocyanide, $Cu_4Fe(CN)_6$.

Insol. in H_2O ; sol. in NH_4OH+Aq ; insol. in NH_4Cl+Aq.

Cupric ferrocyanide, basic, $CuFe(OH)_4(CN)_4$.

Ppt. (Bong, Bull. Soc. **23.** 231.)

Cupric ferrocyanide, $Cu_2Fe(CN)_6+7H_2O$.

Insol. in H_2O or acids. Insol. in NH_4 salts $+Aq$. Sol. in NH_4OH+Aq. Sol. in $(NH_4)_2C_2O_4+Aq$ and in $KCN+Aq$.

$+10H_2O$. Sol. in excess of $K_4Fe(CN)_6+Aq$, especially if hot. (Wyrouboff.)

Cupric ferrocyanide ammonia (cuprammonium ferrocyanide), $Cu_2Fe(CN)_6$, $4NH_3+H_2O$.

Insol. in H_2O or alcohol. Sol. in NH_4OH+Aq. (Bunsen.)

$Cu_2Fe(CN)_6$, $8NH_3+H_2O$.

Cuprous potassium ferrocyanide, $K_2Cu_2Fe(CN)_6+1\frac{1}{2}H_2O$.

Insol. in H_2O, alcohol, or ether.

Decomp. by acids. Sol. in $KCN+Aq$.

$K_3Cu_2Fe(CN)_6+4H_2O$.

$+5H_2O$. (Wonfor.)

$+6H_2O$. (Wyrouboff.)

Cupric potassium ferrocyanide, $K_2CuFe(CN)_6+H_2O$.

Insol. in cold, sl. decomp. by boiling H_2O.

$K_2Cu_3[Fe(CN)_6]_2+12H_2O$. Ppt.

Cuprous sodium ferrocyanide, $Cu_2Na_2Fe(CN)_6$.

Ppt.

Cupric sodium ferrocyanide, $CuNa_2Fe(CN)_6$.

Ppt.

Didymium potassium ferrocyanide, $DiKFe(CN)_6+4H_2O$.

Ppt. (Cleve.)

$+2H_2O$. (Wyrouboff.)

Erbium potassium ferrocyanide, $ErKFe(CN)_6+xH_2O$.

(Höglund.)

Gallium ferrocyanide.

Sol. in boiling $HCl+Aq$. (de Boisbaudran, C. R. **99.** 526.)

Glucinum ferrocyanide, $Gl_2Fe(CN)_6$, $4GlO_2H_2+7H_2O$ (?).

Sol. in H_2O. (Atterberg.)

Ferric ferrocyanide, $Fe_7(CN)_{18}=Fe_4[Fe(CN)_6]_3+xH_2O$.

(*Prussian blue.*) Insol. in H_2O, alcohol, ether, or oils. Decomp. slowly by boiling H_2O. Insol. in dil. mineral acids. Sol. in conc. $HCl+Aq$, and conc. H_2SO_4 without decomp. Sol. in $H_2C_2O_4$ or NH_4 tartrate $+Aq$. Insol. in NH_4OH+Aq. Decomp. by NaOH, or $KOH+Aq$. Not pptd. in presence of tartrates or citrates.

Ferrous potassium ferrocyanide, $FeK_2Fe(CN)_6$.

Insol. in H_2O. Decomp. on air.

Ferric potassium ferrocyanide, $FeKFe(CN)_6$.

Is probably ferrous potassium ferricyanide, which see.

Ferric ferrocyanide ammonia, $Fe_4[Fe(CN)_6]_3$, $6NH_3+9H_2O$.

Insol. in NH_4 tartrate +Aq.

Lanthanum potassium ferrocyanide, $LaKFe(CN)_6+4H_2O$.

Ppt.

Lead ferrocyanide, $Pb_2Fe(CN)_6+3H_2O$.

Insol. in H_2O, acids, or NH_4OH+Aq. (Wyrouboff, A. ch. (5) **8.** 480.)

Sl. sol. in conc. H_2SO_4, from which it is pptd. by H_2O. (Berzelius.)

Sol. in hot NH_4Cl, or NH_4 succinate+Aq; insol. in other NH_4 salts +Aq. (Wittstein.)

Insol. in NH_4Cl+Aq. (Brett.)

Not pptd. in presence of Na citrate. (Spiller.)

Lithium ferrocyanide, $Li_4Fe(CN)_6+9H_2O$.

Deliquescent. Very sol. in H_2O.

Lithium potassium ferrocyanide, $Li_2K_2Fe(CN)_6+3H_2O$.

Very sol. in H_2O. Sol. in 1·5 pts. H_2O at ord. temp. (Wyrouboff, A. ch. (4) **21.** 274.)

Magnesium ferrocyanide, $Mg_2Fe(CN)_6+6H_2O$.

Sol. in 3 pts. cold H_2O. (Bette, A. **22.** 148.)

Magnesium potassium ferrocyanide, $MgK_2Fe(CN)_6$ (?).

Sol. in 1575 pts. H_2O at 15°, and 238 pts. at 100°. Solution is decomp. by boiling. (Storer's Dict.)

Manganous ferrocyanide, $Mn_2Fe(CN)_6+7H_2O$.

Insol. in H_2O. Sol. in HCl+Aq. Insol. in NH_4Cl, or NH_4NO_3+Aq.

Manganous potassium ferrocyanide, $MnK_2Fe(CN)_6$.

Ppt. (Berzelius.)

$5Mn_2Fe(CN)_6$, $4K_4Fe(CN)_6+4H_2O$ (?). Ppt. Sol. in dil. HCl+Aq. (Wyrouboff.)

Molybdenum ferrocyanide, $Mo_4Fe(CN)_6+20H_2O$ (?).

Very sol. in NH_4OH+Aq. (Wyrouboff.)

$Mo_2Fe(CN)_6+8H_2O$ (?). (W.)

$+14\ H_2O$ (?). Very sol. in H_2O; insol. in alcohol. (W.)

Molybdenum potassium ferrocyanide, $K_4Mo_2[Fe(CN)_6]_2+40H_2O$ (?). (Wyrouboff.)

$K_2(MoO_2)_2[Fe(CN)_6]_2$, $2MoO_3+20H_2O$ (?). (Atterberg.)

$K_6Mo_2[Fe(CN)_6]_2$, $2MoO_3+12H_2O$ (?). (Atterberg.)

Nickel ferrocyanide, $Ni_2Fe(CN)_6+11H_2O$, or $14H_2O$.

Ppt. Insol. in H_2O or HCl+Aq. Sol. in NH_4OH+Aq; insol. in NH_4 salts +Aq. Sol. in KCN+Aq.

Nickel ferrocyanide ammonia, $Ni_2Fe(CN)_6$, $4NH_3+H_2O$.

Completely insol. in H_2O and not attacked thereby; sol. in NH_4OH+Aq to form—

$Ni_2Fe(CN)_6$, $10NH_3+4H_2O$. Decomp. by hot H_2O. (Reynoso, A. ch. (3) **30.** 252.)

$Ni_2Fe(CN)_6$, $2NH_3+4$, and $9H_2O$. Hygroscopic. Easily decomp. (Gintl, J. B. **1868.** 304.)

$Ni_2Fe(CN)_6$, $8NH_3+4H_2O$. Sol. in NH_4OH+Aq. (G.)

$Ni_2Fe(CN)_6$, $12NH_3+9H_2O$. Sol. in NH_4OH+Aq, but less so than the above compounds. (G.)

Nickel potassium ferrocyanide, $NiK_2Fe(CN)_6+3H_2O$.

Ppt. (Wyrouboff.)

Osmium ferrocyanide, $Os_2Fe(CN)_6$.

Ppt. (Martius, A. **117.** 368.)

Potassium ferrocyanide, $K_4Fe(CN)_6+3H_2O$.

Permanent. Easily sol. in cold, and more easily in hot H_2O.

Sol. in 4·23 pts. H_2O at 15°, or 100 pts. H_2O dissolve 23·6 pts. salt at 15°. (Schiff, A. **113.** 350.)

100 pts. H_2O dissolve 27·8 pts. at 12·2°; 65·8 pts. at 37·7°; 87·6 pts. at 65·5°; and 90·6 pts. at 96·3°. (Thomson.)

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Wittstein.)

100 pts. H_2O dissolve 29·2 pts. salt at 15°, and solution has sp. gr. = 1·1441. (Michel and Krafft, A. ch. (3) **41.** 478.)

$K_4Fe(CN)_6$+Aq sat. at 8° has sp. gr. = 1·13. (Anthon.)

Sp. gr. of $K_4Fe(CN)_6$+Aq at 15°.

% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.
1	1·0058	8	1·0479	15	1·0932
2	1·0116	9	1·0542	16	1·0999
3	1·0175	10	1·0605	17	1·1067
4	1·0234	11	1·0669	18	1·1136
5	1·0295	12	1·0734	19	1·1205
6	1·0356	13	1·0800	20	1·1275
7	1·0417	14	1·0866	...	...

(Schiff, A. **113.** 199.)

Insol. in alcohol, even when dilute.

Potassium samarium ferrocyanide, $KSmFe(CN)_6+5H_2O$.

Precipitate. (Cleve.)

Potassium sodium ferrocyanide, $KNa_3Fe(CN)_6+12H_2O$.

Sol. in H_2O.

$K_2Na_2Fe(CN)_6+8H_2O$. Easily sol. in H_2O.

$K_3NaFe(CN)_6+3H_2O$. Permanent. Easily sol. in H_2O; insol. in alcohol.

Potassium sodium ferrocyanide nitrate, $K_2Na_2Fe(CN)_6$, $4KNO_3$.

Sol. in H_2O. (Martius.)

Potassium strontium ferrocyanide, $K_2SrFe(CN)_6+3H_2O$.

Easily decomp. Sol. in H_2O; sl. sol. in alcohol. (Wyrouboff, A. ch. (4) **21.** 276.)

Potassium stannic ferrocyanide, $KSn_3[Fe(CN)_6]_3+68H_2O$ (?).

Ppt. (Wyrouboff.)

$K_4Sn_{10}[Fe(CN)_6]_{11}+230H_2O$ (?). (Atterberg.)

Potassium titanium ferrocyanide, $K_3Ti_3[Fe(CN)_6]_2+11H_2O$ (?).

Ppt. Sol. in $K_4Fe(CN)_6$+Aq. (Wyrouboff.)

$K_4Fe(CN)_6$, $11Ti_2Fe(CN)_6+43H_2O$ (?). Ppt. (Wyrouboff.)

$K_2(TiO)_3[Fe(CN)_6]_2+23H_2O$ (?). Ppt. (Atterberg.)

$K_2(TiO)_{11}[Fe(CN)_6]_6+110H_2O$ (?). Ppt. (Atterberg.)

Potassium tungsten ferrocyanide, $KW_2Fe(CN)_6+7H_2O$ (?).

Sol. in H_2O. (Wyrouboff.)

$K_2W_5Fe(CN)_6+20H_2O$ (?). Sol. in H_2O. (W.)

Potassium uranium ferrocyanide, $K_2U_3[Fe(CN)_6]_2+6H_2O$ (?).

Ppt. (Wyrouboff.)

$K_2(UO_2)_3[Fe(CN)_6]_2+6H_2O$. Ppt. (Atterberg.)

$K_6(UO_2)_5[Fe(CN)_6]_4+12H_2O$. Sol. in H_2O. (Atterberg.)

Potassium vanadium ferrocyanide, $K_{18}V[Fe(CN)_6]_6+39H_2O$ (?).

Ppt. Sl. sol. in H_2O. (Wyrouboff.)

$K_6(VO)_5[Fe(CN)_6]_4+60H_2O$ (?). Ppt. (Atterberg.)

Potassium yttrium ferrocyanide, $KYFe(CN)_6+2H_2O$.

Ppt. (Wyrouboff, A. ch. (5) **8.** 444.)

Potassium zinc ferrocyanide, $K_4Zn_6[Fe(CN)_6]_4+12H_2O$.

Absolutely insol. in H_2O. (Wyrouboff, A. ch. (5) **8.** 485.)

Potassium ferrocyanide carbonyl, $K_3Fe(CN)_5(CO)+3\frac{1}{2}H_2O$.

See **Carbonyl ferrocyanide, potassium.**

Rubidium ferrocyanide, $Rb_4Fe(CN)_6+2H_2O$.

Sol. in less than 1 pt. H_2O at ord. temp. with great absorption of heat. (Wyrouboff, A. ch. (4) **16.** 307.)

Silver ferrocyanide, $Ag_4Fe(CN)_6+H_2O$.

Insol. in H_2O or dil. acids. Insol. in NH_4OH, or NH_4 salts +Aq. Sol. in KCN+Aq.

Decomp. by warm NH_4OH+Aq. (Weith, Z. Ch. (2) **5.** 381.)

Silver ferrocyanide ammonia, $Ag_4Fe(CN)_6$, $2NH_3+H_2O$.

(Wyrouboff.)

$+6H_2O$. (Gintl.)

Sodium ferrocyanide, $Na_4Fe(CN)_6+12H_2O$.

Efflorescent. Less sol. in H_2O than $K_4Fe(CN)_6$. Sol. in 4·5 pts. H_2O at 12°. (John.)

100 pts. H_2O at 15·5° dissolve 22 pts. (Ure's Dict.)

Insol. in alcohol.

$+9H_2O$. (Weith, A. **147.** 329.)

$+10H_2O$. (Pebal, A. **233.** 165.)

Strontium ferrocyanide, $Sr_2Fe(CN)_6+15H_2O$.

Efflorescent. Sol. in 2 pts. cold, and less than 1 pt. boiling H_2O. (Bette.)

Excessively sol. in H_2O. (Wyrouboff, A. ch. (4) **16.** 280.)

$+8H_2O$. (Wyrouboff.)

Thallous ferrocyanide, $Tl_4Fe(CN)_6+2H_2O$.

100 pts. H_2O dissolve 0·37 pt. at 18°, and 3·93 pts. at 101°. (Lamy.)

Sol. in KCN+Aq. (Kühlmann.)

Thorium ferrocyanide, $ThFe(CN)_6+4H_2O$.

Ppt. (Cleve, Bull. Soc. (2) **24.** 355.)

Stannous ferrocyanide, $Sn_2Fe(CN)_6+4H_2O$.

Insol. in H_2O or acids; sl. sol. in NH_4OH+Aq. (Wyrouboff.)

Stannic ferrocyanide, $Sn_5[Fe(CN)_6]_2+18\frac{1}{3}H_2O$ (?).

(Wyrouboff.)

Titanium ferrocyanide, $Ti_7[Fe(CN)_6]_2$ (?).

Ppt. (Wyrouboff.)

Uranium ferrocyanide, $UFe(CN)_6+10H_2O$.

Ppt. (Wyrouboff.)

Vanadyl ferrocyanide, $(VO)_2Fe(CN)_6+11H_2O$.

Ppt. (Atterberg.)

Yttrium ferrocyanide, $Y_4[Fe(CN)_6]_3$.

Easily sol. in H_2O; insol. in alcohol. (Popp, A. **131.** 179.)

Zinc ferrocyanide, $Zn_2Fe(CN)_6+3H_2O$.

Insol. in H_2O or acids.

Insol. in HCl+Aq. (Lea, Sill. Am. J. (2) **31.** 191.)

Sol. in NH_4OH, or NH_4 salts +Aq. (Wittstein.)

Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sl. sol. in boiling $K_4Fe(CN)_6$, or $K_3Fe(CN)_6$+Aq. (Gore.)

$+4H_2O$. Absolutely insol. in H_2O. (Wyrouboff, A. ch. (5) **8.** 485.)

Ferro*tetra*nitrososulphydric acid, $H_2S_2(NO)_4Fe_2$.

Insol. in H_2O; sl. sol. in alcohol; more easily in ether; very sol. in CS_2 or $CHCl_3$. Not obtained in a pure state. (Pawel, B. **15.** 2600.)

Ethyl ferro*tetra*nitrososulphide, $(C_2H_5)_2S_2(NO)_4Fe_2$.

Insol. in H_2O, difficultly sol. in alcohol, more easily in ether, and very easily in CS_2, $CHCl_3$, C_2H_5I, or C_6H_6. (Pawel, B. **15.** 2609.)

Ferrous ——, $FeS_2(NO)_4Fe_2$.

More difficultly sol. in H_2O and alcohol than the *hepta* salt.

Sol. in ether.

Potassium ferro*tetra*nitrososulphide, $K_2S_2(NO)_4Fe_2+4H_2O$.

Sol. in H_2O. Easily sol. in alcohol; insol. in ether. (Pawel, B. **15.** 2600.)

True composition of "nitrosulphide of iron and potassium" of Roussin. (A. ch. (3) **52.** 297.) (Pawel, B. **13.** 1949.)

Sodium ——, $Na_2S_2(NO)_4Fe_2+8H_2O$.

Sol. in H_2O; easily sol. in alcohol; insol. in ether. (Pawel.)

True composition of "nitrosulphide of iron and sodium" of Roussin. (Pawel.)

Thallium ——, $Tl_2S_2(NO)_4Fe_2$.

Insol. in H_2O, alcohol, or ether. (Pawel.)

Ferro*hepta*nitrososulphydric acid, $HS_3(NO)_7Fe_4$.

Insol. in H_2O, alcohol, and ether. Easily sol. in CS_2 or $CHCl_3$. (Pawel, B. **15.** 2604.)

May be called Ferrinitrososulphydric acid.

Ammonium ferro*hepta*nitrososulphide, $NH_4S_3(NO)_7Fe_4+H_2O$.

Less easily sol. in H_2O than the K compound. (Pawel, B. **15.** 2600.)

"*Bi*nitrosulphide of iron" of Roussin. Sol. in about 2 pts. boiling H_2O; very sl. sol. in cold H_2O. Very sol. in alcohols, methyl, ethyl, or amyl, and in $HC_2H_3O_2$. Miscible with ether. Insol. in CS_2 or $CHCl_3$.

Decomp. by conc. HCl, HNO_3, or H_2SO_4.

Not attacked by $H_2C_2O_4$, or $H_2C_4H_4O_6+Aq$.

Insol. in NH_4OH, and KOH+Aq. (Roussin, A. ch. (3) **52.** 286.)

Barium ——.

Easily sol. in H_2O. (Pawel.)

Cæsium ——.

Insol. in H_2O. Difficultly sol. in alcohol and ether. (Pawel.)

Calcium ——.

Easily sol. in H_2O. (Pawel.)

Ferrous ——, $Fe[S_3(NO)_7Fe_4]_2+8H_2O$.

More easily sol. in H_2O than Na salt. (Pawel.)

Lead ——.

Difficultly sol. in H_2O. (Pawel.)

Magnesium ——.

Easily sol. in H_2O. (Pawel.)

Potassium ——, $KS_3(NO)_7Fe_4$.

Sol. in H_2O, alcohol, and very sol. in ether with slight decomp. (Pawel, B. **15.** 2600.)

Rubidium ——, $RbS_3(NO)_7Fe_4$.

Less soluble in H_2O than the NH_4 salt. (Pawel.)

Sodium ——, $NaS_3(NO)_7Fe_4+2H_2O$.

More sol. in H_2O than the potassium salt. (Pawel.)

Thallium ——, $TlS_3(NO)_7Fe_4+H_2O$.

Very difficultly sol. in H_2O. More easily sol. in alcohol. (Pawel.)

Ferrotungstic acid.

Sol. in H_2O. (Laurent, C. R. **31.** 693.)

Ammonium manganous ferrotungstate, $12(NH_4)_2O, 6MnO, 2Fe_2O_3, 3H_2O, 45WO_3+81H_2O$.

Sol. in H_2O. (Laurent.)

Barium ferrotungstate, $21BaO, 2Fe_2O_3, 45WO_3+27H_2O$.

Sol. in H_2O. (Laurent.)

Potassium ferrotungstate, $9K_2O, 2Fe_2O_3, 12H_2O, 45WO_3+54H_2O$.

Sol. in H_2O. (Laurent.)

$18K_2O$, $2Fe_2O_3$, $3H_2O$, $45WO_3+54H_2O$. (Laurent.)

Ferrous acid.

Barium ferrite, BaO, Fe_2O_3.

Ppt. (List, B. **11.** 1512.)

Calcium ferrite, $4CaO, Fe_2O_3$.

Insol. in H_2O, or sugar+H_2O. Decomp. by the weakest acids, but not by boiling KOH+Aq. (Pelouze, A. ch. (3) **33.** 5.)

CaO, Fe_2O_3. (List.)

Calcium ferrite chloride, $CaO, Fe_2O_3, CaCl_2$.

Not decomp. by H_2O. (Chatelier, C. R. **99.** 276.)

Cupric ferrite, CuO, Fe_2O_3.

Ppt. (List.)

$+5H_2O$. (List.)

Ferrous argentous ferrite, $2FeO, Ag_4O, Fe_2O_3$ (?).

Easily decomp. by HCl+Aq. Not completely sol. in dil. HNO_3+Aq. Easily sol. in conc. HNO_3. Decomp. by acetic acid. (Rose, Pogg. **10.** 323.)

Magnesium ferrite, MgO, Fe_2O_3.

Insol. in H_2O. Not attacked by boiling conc. HNO_3. (Deville, C. R. **52.** 1264.)

Min. *Magnesioferrite.* Difficultly sol. in HCl+Aq. (Rammelsberg, Pogg. **107.** 451.)

$+4H_2O$. Ppt. (List, B. **11.** 1512.)

$6MgO, Fe_2O_3+9H_2O$. Ppt.

$+15H_2O$. Min. *Pyroaurite.*

Manganous ferrite, MnO, Fe_2O_3.

Ppt. (List.)

Nickel ferrite, NiO, Fe_2O_3.

Ppt. (List.)

Potassium ferrite, $3K_2O, 4Fe_2O_3$.

Decomp. by H_2O, KOH+Aq, NaOH+Aq, etc., but only slowly by NH_4Cl+Aq. (Salm-Horstmar, J. pr. **55.** 349.)

$K_2Fe_2O_4$. Decomp. by H_2O. (Rousseau and Bernheim, C. R. **107.** 240.)

Silver (argentous) ferrite, Ag_4O, Fe_2O_3 (?).

Decomp. by dil. HNO_3+Aq. (Rose, Pogg. **10.** 323.)

Sodium ferrite, Na_2O, Fe_2O_3.

Na_2O is dissolved out by H_2O. Easily sol. in dil. HCl+Aq. Not easily decomp. by NH_4Cl+Aq. (Salm-Horstmar.)

Zinc ferrite, ZnO, Fe_2O_3.

Sol. in boiling conc. $HCl+Aq$. (Ebelmen, A. ch. (3) **33.** 47.)

Min. *Franklinite.*

Flavocobaltic compounds.

See also **Xanthocobaltic compounds.**

Flavocobaltic chloraurate, $(NO_2)_2Co(NH_3)_4AuCl_4$.

More easily sol. than the chloroplatinate. Not wholly insol. in absolute alcohol. (Jörgensen, Z. anorg. **5.** 159.)

—— **chloroplatinate,** $[(NO_2)_2Co(NH_3)_4]_2PtCl_6$.

As the chloroplatinite. (Jörgensen.)

—— **chloroplatinite,** $[(NO_2)_2Co(NH_3)_4]_2PtCl_4$.

Somewhat sol. in H_2O, and not insol. in 50 % alcohol. (Jörgensen.)

—— **chromate,** $[(NO_2)_2Co(NH_3)_4]_2Cr_2O_7$.

Ppt. (Jörgensen.)

—— **nitrate,** $Co(NO_2)_2(NH_3)_4NO_3$.

Sol. in about 33 pts. cold H_2O; insol. in HNO_3. (Jörgensen.)

$Co(NO_2)_2(NH_3)_4NO_3, HNO_3$. Decomp. by H_2O or alcohol. (Jörgensen.)

—— **cobaltic nitrite,** $3(NO_2)_2Co(NH_3)_4, Co(NO_2)_6+2H_2O$.

Sl. sol. in H_2O. (Jörgensen, Z. anorg. **5.** 179.)

—— **diamine cobaltic nitrite,** $(NO_2)_2Co(NH_3)_4, (NO_2)_2(NH_3)_2Co(NO_2)_2$.

Very sl. sol. in H_2O. (Jörgensen.)

—— **sulphate,** $[(NO_2)_2Co(NH_3)_4]_2SO_4$.

Sl. sol. in H_2O, more easily in $HC_2H_3O_2+Aq$. (Jörgensen.)

Fluoborhydric acid, HBF_4.

Decomp. by H_2O very rapidly. (Landolph, C. R. **86.** 603.)

Aluminum fluoboride, $2AlF_3, 3BF_3$.

Sol. in H_2O only when acidulated; sol. in acids. (Berzelius.)

Ammonium fluoboride, NH_4BF_4.

Easily sol. in H_2O. Sol. in 4 pts. H_2O at 16°, and 1·02-1·05 pts. boiling H_2O. (Stolba, Chem. techn. Cent. Anz. **7.** 459.) Sl. sol. in alcohol.

Barium fluoboride, $Ba(BF_4)_2+2H_2O$.

Deliquescent; easily sol. in H_2O; decomp. by alcohol. (Berzelius.)

Cæsium fluoboride, $CsBF_4$.

100 pts. H_2O dissolve 0·92 pt. $CsBF_4$ at 20°, and 0·04 pt. at 100°. (Godeffroy, B. **9.** 1367.)

Calcium fluoboride, $Ca(BF_4)_2$.

Decomp. by H_2O, with formation of a sol. acid salt and an insol. basic salt. (Berzelius.)

Cupric fluoboride, $Cu(BF_4)_2$.

Deliquescent, and very sol. in H_2O. (Berzelius.)

Lead fluoboride, $Pb(BF_4)_2$.

Sol. in H_2O. Decomp. by boiling with H_2O or alcohol into an acid soluble, and a basic insoluble salt. (Berzelius.)

Lithium fluoboride, $LiBF_4$.

Hygroscopic. Easily sol. in H_2O. (Berzelius.)

Magnesium fluoboride.

Easily sol. in H_2O. (Berzelius.)

Potassium fluoboride, KBF_4.

Sol. in 223 pts. H_2O at 20°. (Stolba.)

Sol. in 70·4 pts. cold H_2O. (Berzelius.)

Sol. in 15·94 pts. H_2O at 100°. (Stolba.)

Not more sol. in NH_4OH+Aq than in H_2O; sol. in hot KOH, NaOH, or M_2CO_3+Aq. (Berzelius.) More sol. in NH_4Cl+Aq. (Rose, Pogg. **80.** 276.) Insol. in 20 % $KC_2H_3O_2+Aq$. (Stromeyer.) Insol. in cold, sl. sol. in boiling alcohol.

Rubidium fluoboride, $RbBF_4$.

100 pts. H_2O dissolve 0·55 pt. at 20°, and 1·0 pt. at 100°. (Godeffroy, B. **9.** 1337.)

Sodium fluoboride, $NaBF_4$.

Easily sol. in H_2O. Very sl. sol. in alcohol. (Berzelius.)

Yttrium fluoboride.

Sol. in H_2O with excess of acid. (Berzelius.)

Zinc fluoboride, $Zn(BF_4)_2$.

Deliquescent. Sol. in H_2O. (Berzelius.)

Fluoboric acid, HBF_4.

See **Fluoborhydric acid.**

$H_4B_2O_7, 3HF$, and $H_4B_2O_9, 2HF$ (?). Fume on air, and are decomp. with H_2O. (Landolph, B. **12.** 1583.)

$HBO_2, 3HF$. Decomp. by H_2O. (Berzelius, Pogg. **59.** 644.)

Is either a mixture, or a solution of HBO_2 in HF, and is decomp. by distillation, and the salts are decomp. by recrystallisation. (Basarow, C. R. **78.** 1698.)

Potassium fluoborate, $K_2B_2O_3F_2$ (?).

Sl. deliquescent. Scarcely sol. in boiling alcohol. (Schiff, A. Suppl. **5.** 175.)

See **Boron** *tri***oxide potassium fluoride,** $B_2O_3, 2KF$.

Fluochromic acid.

Ammonium fluochromate, NH_4CrO_3F.

Sol. in H_2O. (Varenne, C. R. **91.** 989.)

Potassium fluochromate, $KCrO_3F$.

Efflorescent. Sol. in H_2O, with gradual decomp. (Streng, A. **129.** 225.)

Fluocolumbic acid.

See also **Fluoxycolumbic acid.**

Ammonium fluocolumbate fluoxycolumbate, $(NH_4)_2CbF_5, 2CbOF_3, NH_4F$.

Cadmium fluocolumbate, $Cd_5H_5Cb_3F_{30}+28H_2O$.

Insol. in, and decomp. by H_2O. (Streng.)

Cobalt fluocolumbate, $Co_5H_5Cb_3F_{30}+28H_2O$.
Insol. in, and decomp. by H_2O. (Streng.)

Copper fluocolumbate, $Cu_2HCbF_{10}+9H_2O$.
Insol. in, and decomp. by H_2O.

Ferrous fluocolumbate, $Fe_3H_4Cb_2F_{20}+19H_2O$.
As above.

Manganous fluocolumbate, $Mn_5H_5Cb_3F_{30}+28H_2O$.

Mercuric fluocolumbate, $Hg_3CbF_{11}+8H_2O$.
As above.

Nickel fluocolumbate, $Ni_3H_4Cb_2F_{20}+19H_2O$.
As above.

Potassium fluocolumbate, K_2CbF_7.
Decomp. by solution in H_2O. (Marignac, A. ch. (4) **8.** 34.)

Zinc fluocolumbate, $Zn_5H_5Cb_3F_{30}+28H_2O$.
Insol. in cold H_2O; decomp. by hot H_2O. (Santesson, Bull. Soc. (2) **24.** 52.)

Fluogermanic acid, H_2GeF_6.

Known only in solution. (Winkler, J. pr. (2) **36.** 177.)

Potassium fluogermanate, K_2GeF_6.
Sol. in 173·98 pts. H_2O at 18°. (Winkler.)
Sol. in 184·61 pts. H_2O at 18°. (Krüss and Nilson, B. **20.** 1696.)
Sol. in 34·07 pts. H_2O at 100°. (Winkler.)
Sol. in 38·76 pts. H_2O at 100°. (Krüss and Nilson.)
Insol. in alcohol.

Fluomanganic acid, H_2MnF_6.

Decomp. by H_2O. Sol. in alcohol and ether in absence of H_2O. (Nicklès, C. R. **65.** 107.)

Ammonium fluomanganate, $(NH_4)_2MnF_6$.
More sol. than the K salt. (Nicklès, C. R. **65.** 107.)
True composition is $(NH_4)_4Mn_2F_{10}=4NH_4F, Mn_2F_6$. (Christensen, J. pr. (2) **34.** 41.)

Cobalt fluomanganate, $2CoF_2, Mn_2F_6+8H_2O$.
Sol. in H_2O. (Christensen.)

Nickel fluomanganate, $2NiF_2, Mn_2F_6+8H_2O$.
Sol. in H_2O. (Christensen.)

Potassium fluomanganate, K_2MnF_6.
Difficultly sol. in H_2O. Decomp. by much H_2O. (Nicklès, C. R. **65.** 107.)
Composition is $K_4Mn_2F_{10}=4KF, Mn_2F_6$. Also with $2H_2O$. (Christensen, J. pr. (2) **34.** 41.)

Silver fluomanganate, $Ag_2Mn_2F_8+14H_2O$.
(Christensen, J. pr. (2) **34.** 41.)

Sodium fluomanganate, $4NaF, Mn_2F_6$.
Decomp. by much H_2O. (Christensen.)

Zinc fluomanganate, $2ZnF_2, Mn_2F_6+8H_2O$.
Sol. in H_2O. (Christensen.)

Fluomolybdic acid.

See **Fluoxyhypomolybdic,** *and* **Fluoxymolybdic acids.**

Fluopalladous acid.

Potassium fluopalladite.
Sl. sol. in H_2O.

Sodium fluopalladite.
Sl. sol. in H_2O. (Berzelius.)

Fluophosphamide, $PF_3(NH_2)_2$.

Sol. in H_2O. (Poulenc, A. ch. (6) **24.** 566.)

Fluoplatinic acid.

Ammonium fluoplatinate.
Decomp. by H_2O to a sol. acid, and an insol. basic salt. Insol. in alcohol. (Berzelius.)

Potassium fluoplatinate.
Deliquescent. Insol. in alcohol. Decomp. by H_2O. (Berzelius.)

Sodium fluoplatinate.
Decomp. by H_2O. (Berzelius.)

Fluor- *and* Fluoro-.

See **Fluo-.**

Fluorhydric (Hydrofluoric) acid, HF or H_2F_2.

Attracts H_2O from air with great avidity. Very sol. in H_2O with evolution of much heat.

Sat. solution has sp. gr. 1·25. (H. Davy.)

On boiling the aqueous solution an acid of constant composition is obtained, which boils at 120°, has sp. gr. 1·15, and contains 35·37 % HF (Bineau, A. ch. (3) **7.** 257). The residual acid after boiling contains 36 to 38 % HF, and by standing over CaO gives off HF until an acid containing 32·5 to 32·7 % HF is formed. Weaker acids increase their strength to 32·2 to 32·4 % HF, while an acid containing 32·5 % HF remains unchanged. (Roscoe, A. **116.** 218.)

Does not attack gutta-percha. Sol. in H_2SO_4.

Sp. gr. of HF + Aq at 15°.

Sp. gr.	% HF	Sp. gr.	% HF	Sp. gr.	% HF
1·01	2·90	1·10	29·00	1·19	55·10
1·02	5·80	1·11	31·90	1·20	58·00
1·03	8·70	1·12	34·80	1·21	60·90
1·04	11·60	1·13	37·70	1·22	63·80
1·05	14·50	1·14	40·60	1·23	66·70
1·06	17·40	1·15	43·50	1·24	69·60
1·07	20·30	1·16	46·40	1·25	72·50
1·08	23·20	1·17	49·30	...	...
1·09	26·10	1·18	52·20	...	...

(Hart, J. Anal. Ch. **3.** 372.)

Fluorides.

The alkali fluorides, also AgF and SnF_2, are sol. in H_2O; the fluorides of Fe, Sr, and Cd are sl. sol.; the others are insol. in H_2O. Most fluorides are sol. in acids, especially HF + Aq.

See under each element.

Fluorine, F_2.

Decomposes H_2O and all organic solvents with great violence. (Moissan, C. R. **103.** 202 and 256.)

Fluosilicic acid, H_2SiF_6.

$+2H_2O$. Very deliquescent, and sol. in H_2O. (Kessler, C. R. **90.** 1285.) Solution decomp. into HF and SiF_4 on evaporation, when it becomes concentrated.

Sp. gr. of H_2SiF_6+Aq at 17·5° (H_2O at 17·5°=1·000).

% H_2SiF_6	Sp. gr.	% H_2SiF_6	Sp. gr.
2	1·0161	20	1·1748
4	1·0324	22	1·1941
6	1·0491	24	1·2136
8	1·0661	26	1·2335
10	1·0834	28	1·2537
12	1·1011	30	1·2742
14	1·1190	32	1·2951
16	1·1373	34	1·3162
18	1·1559	...	...

(Stolba, J. pr. **90.** 193.)

Fluosilicates.

Most of the fluosilicates are sol. in H_2O, but the alkali salts (especially K) and the Ba salt are only sl. sol. in H_2O.

Aluminum fluosilicate, $Al_2(SiF_6)_3$.

Easily sol. in H_2O. After evaporating to dryness, the residue is slowly but completely sol. in H_2O. (Deville, A. ch. (3) **61.** 327.)

Aluminum fluosilicate silicate, Al_2SiF_{10}, $5Al_2SiO_5$.

Min. *Topaz.* Insol. in acids.

Ammonium fluosilicate, $(NH_4)_2SiF_6$.

Sol. in 5·38 pts. H_2O at 17·5° to form a solution of 1·0961 sp. gr.; sol. in 1·8 pts. hot H_2O; sol. in 45·5 pts. alcohol of 31 %. (Stolba, C. C. **1877.** 418.)

$3NH_4F$, $SiF_4=(NH_4)_2SiF_6$, NH_4F. Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 221.)

Barium fluosilicate, $BaSiF_6$.

Sol. in 3802 pts. cold H_2O. (Fresenius, A. **59.** 120.)

Sol. in 3731 pts. H_2O at 17·5°; in 3315 pts. at 21°; in 1175 pts. at 100°. (Stolba, J. pr. **96.** 22.)

Sol. in 640-733 pts. H_2O containing a little HCl. (Fresenius.)

488 pts. HCl+Aq containing 4·25 % HCl dissolve 1 pt. at 22°. (Stolba.)

More sol. in HNO_3+Aq than in H_2O. (Fresenius.)

272 pts. HNO_3+Aq, containing 8 % N_2O_5, dissolve 1 pt. at 22°. (Stolba.)

1 pt. $BaSiF_6$ dissolves in 428 pts. sat. NH_4Cl+Aq; in 589 pts. sat. NH_4Cl+Aq+2 vols. H_2O. (Mallet, Sill. Am. J. (2) **28.** 48.)

1 pt. $BaSiF_6$ dissolves in 306 pts. sat. NH_4Cl+Aq at 22°; in 361 pts. 15 % solution of NH_4Cl; in 563 pts. sat. boiling NaCl+Aq; in 349 pts. 10 % solution of NaCl at boiling temp.; in 2185 pts. 10 % solution of NaCl at 20°; in 1140 pts. 5 % solution of NaCl at 20°. (Stolba.)

Nearly absolutely insol. in alcohol. (Fresenius.)

Solubility in a mixture of H_2O, alcohol (96 %), HCl+Aq (20 %), H_2SiF_6+Aq (3·7 %). 1 pt. $BaSiF_6$ is sol. in pts. of solutions of given composition.

H_2O	Alcohol	HCl+Aq	H_2SiF_6 +Aq	$BaSiF_6$
50	50	0	0	37,219
74·1	25	0·9	0	5,263
70·8	25	4·2	0	2,860
77·95	20	0·9	1·15	39,061
73·0	25	0·9	1·1	70,679
97·09	0	1·25	1·66	3,247
75·0	25	0	0	16,914

(Fresenius, Z. anal. **29.** 143.)

Cæsium fluosilicate, Cs_2SiF_6.

Sol. in 166 pts. H_2O at 17°, and much easier in hot H_2O. Insol. in alcohol. (Preis, J. pr. **103.** 410.)

Cadmium fluosilicate.

Efflorescent. Very easily sol. in H_2O.

Calcium fluosilicate, $CaSiF_6+2H_2O$.

Sl. sol. in, and partly decomp. by H_2O. Sol. in HF and HCl+Aq. Sol. in fluosilicic acid without decomp. Easily sol. in 60 % alcohol. (Fleischer.)

Cerium fluosilicate.

Very difficultly sol. in H_2O, acetic, or fluosilicic acids. Insol. in alcohol. (Stolba, C. C. **1874.** 130.)

Chromium fluosilicate.

Deliquescent. (Berzelius.)
Efflorescent. Sol. in H_2O. (Berlin.)

Cobaltous fluosilicate, $CoSiF_6+6H_2O$.

Easily sol. in H_2O. (Berzelius.)

Cuprous fluosilicate, Cu_2SiF_6.

Insol. in H_2O. (Berzelius, Pogg. **1.** 199.)

Cupric fluosilicate, $CuSiF_6+6H_2O$.

Deliquescent in moist, efflorescent in dry air.

Sol. in 0·428 pt. H_2O at 17°. Sp. gr. of solution sat. at 17°=1·6241.

Sol. in 17·5 pts. alcohol of 62 vol. % at 20°; in 150 pts. of 85 % at 20°; in 617 pts. of 92 % at 20°. (Stolba, J. pr. **102.** 7.)

Contains $6\frac{1}{2}$ H_2O. (Stolba.)

$+5\frac{1}{2}H_2O$. (Knop and Wolf.)

Cupric fluosilicate phosphate, $CuSiF_6$, $Cu_3(PO_4)_2$.

Insol. in H_2O, but easily sol. in dil. HCl+Aq. (Thorpe and Rodger, Chem. Soc. **55.** 320.)

Glucinum fluosilicate.

Known only in solution.

Ferrous fluosilicate, $FeSiF_6+6H_2O$.

Easily sol. in H_2O. (Berzelius.)

Ferric fluosilicate, $Fe_2(SiF_6)_3$.

Sol. in H_2O. (Berzelius.)

Lead fluosilicate, $PbSiF_6+2H_2O$.

Deliquescent. Easily sol. in H_2O.
$+4H_2O$. (Marignac.)

Lithium fluosilicate, $Li_2SiF_6+2H_2O$.

100 pts. H_2O at 17° dissolve 73 pts. crystalline salt. (Marignac.)

100 pts. cold H_2O dissolve 52·6 pts. crystals. Sol. in dil. alcohol. (Stolba, J. pr. **91.** 456.)

100 pts. alcohol of 46 vol. % dissolve about 4 pts., and 100 pts. alcohol of 79 vol. % dissolve about 0·4 pt. crystals. (Stolba, Z. anal. **3.** 311.)

Insol. in ether or benzene.

Magnesium fluosilicate, $MgSiF_6+6H_2O$.

Efflorescent. Sol. in 1534 pts. cold H_2O, forming a solution of 1·235 sp. gr. at 17·5°. Separates out SiO_2 on warming, which nearly all redissolves on cooling. (Stolba, C. C. **1877.** 578.)

Magnesium fluosilicate silicate, $Mg_5Si_2F_{18}$, $xMg_5Si_2O_9$.

Min. *Humite; Chondrodite.* Gelatinises with HCl, or H_2SO_4+Aq.

Manganous fluosilicate, $MnSiF_6+6H_2O$.

Sol. in H_2O. (Marignac, J. pr. **83.** 202.)

100 pts. salt dissolve in 71·4 pts. H_2O at 17·5°, and sp. gr. of solution = 1·44825. Much more sol. in hot H_2O, and less sol. in alcohol, the stronger the alcohol. (Stolba, C. C. **1883.** 292.)

Mercurous fluosilicate, $Hg_2SiF_6+2H_2O$.

Sl. sol. in H_2O. More easily sol. in acidified H_2O, but precipitated by $HCl+Aq$. (Berzelius.)

Mercuric fluosilicate, basic, $HgSiF_6$, $HgO+3H_2O$.

Decomp. by H_2O, but sol. in weakest acids. (Berzelius, Pogg. **1.** 200.)

Mercuric fluosilicate, $HgSiF_6+6H_2O$.

Deliquescent, and easily sol. in H_2O. (Finkener, Pogg. **111.** 246.)

Nickel fluosilicate, $NiSiF_6+6H_2O$.

Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 262.)

Potassium fluosilicate, K_2SiF_6.

Sol. in 833·1 pts. H_2O at 17·5°, and 104·8 pts. at 100°. (Stolba, J. pr. **103.** 396.) Sol. in 3800 pts. cold, and more easily sol. in hot H_2O. (Fresenius.)

More sol. in $HCl+Aq$ than in H_2O.

Sol. in 337 pts. $HCl+Aq$ of 26·5 % at 14°; in 307 pts. of 25·7 % at 15°; in 340 pts. of 14·1 % at 14°; in 303 pts. of 13·6 % at 15°; in 327 pts. of 9·6 % at 14°; in 313 pts. of 9·2 % at 15°; in 376 pts. of 2·7 % at 14°; in 319 pts. of 2·4 % at 15°; in 409 pts. of 1·8 % at 14°. (Stolba, *l.c.*)

Sol. in 428 pts. sat., and 589 pts. dil. NH_4Cl+Aq. (Mallet.)

Much less sol. in K_2SO_4, KNO_3, or $KCl+Aq$, but more sol. in NH_4Cl+Aq than in H_2O. (Stolba.)

Sol. in 24,066 pts. K_2SO_4+Aq containing 9·92 % K_2SO_4 at 17°; in 17,858 pts. containing 6 % at 18°; in 19,530 pts. containing 5 % at 17°; in 10,721 pts. containing 1 % at 17°.

Sol. in 125,000 pts. KNO_3+Aq containing 18·4 % KNO_3 at 15°; in 43,478 pts. containing 8·7 % at 15°; in 1735 pts. containing 8·8 % at 100°; in 35,714 pts. containing 4·3 % at 15°; in 10,203 pts. containing 1·00 % at 15°.

Sol. in 40,070 pts. $KCl+Aq$ containing 25 % KCl at 17°; in 38,352 pts. containing 18·4 % at 17°; in 41,254 pts. containing 13·4 % at 14°; in 24,032 pts. containing 6·7 % at 12°; in 1200 pts. containing 0·65 % at 17°; in 1095 pts. containing 0·45 % at 18°.

Sol. in 358 pts. NH_4Cl+Aq containing 26·3 % NH_4Cl at 17°; in 306 pts. containing 15 % at 15°; in 339 pts. containing 10 % at 15°; in 436 pts. containing 5 % at 15°. (Stolba, J. pr. **103.** 306.)

Completely pptd. from aqueous solution by an equal vol. of alcohol.

Rubidium fluosilicate, Rb_2SiF_6.

Sol. in 625 pts. H_2O at 20°, and 73·05-74·5 pts. at 100°. More sol. in acidified water. Insol. in alcohol. (Stolba, J. pr. **101.** 1.)

Silver fluosilicate, $Ag_2SiF_6+4H_2O$.

Deliquescent. Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 221.)

Sodium fluosilicate, Na_2SiF_6.

Much more sol. in H_2O than K_2SiF_6, especially in hot H_2O. Addition of acid does not increase solubility. (Berzelius.)

Sol. in 153·3 pts. H_2O at 17·5°, and 40·66 pts. at 100°. Easily forms supersaturated solutions. (Stolba, Z. anal. **11.** 199.)

Precipitated completely from aqueous solution by alcohol. (Rose.)

Strontium fluosilicate, $SrSiF_6+2H_2O$.

Sol. in cold H_2O, but decomp. somewhat on heating. Sol. in 31·06 pts. H_2O. (Fresenius.)

Easily sol. in acidified H_2O without decomp. Sol. in alcohol.

Solubility in a mixture of H_2O, alcohol (96 %), $HCl+Aq$ (20 %), H_2SiF_6+Aq (3·7 %). 1 pt. $SrSiF_6$ is sol. in pts. of solutions of given composition.

H_2O	Alcohol	$HCl+Aq$	H_2SiF_6+Aq	$SrSiF_6$
50	50	0	0	15·29
74·1	25	0·9	0	82·93
70·8	25	4·2	0	50·9
77·95	20	0·9	1·15	55·0
73	25	0·9	1·1	82·97
75	25	0	0	147·4
95·24	0	2·04	2·72	7·3

(Fresenius, Z. anal. **29.** 143.)

Thallous fluosilicate, $Tl_2SiF_6+2H_2O$.
Very easily sol. in H_2O. (Kuhlmann.)

Thorium fluosilicate, $Th(OH)_2SiF_6$ (?).
(Cleve.)

Stannic fluosilicate, SnF_4, SiF_4.
Very easily sol. in H_2O. (Berzelius.)

Uranyl fluosilicate.
Very sl. sol. in acids. (Berzelius.)
Sol. in alcohol. (Stolba, Z. anal. **3.** 71.)

Vanadium fluosilicate.
Deliquescent. Sol. in H_2O. (Guyard, Bull. Soc. (2) **25.** 352.)

Yttrium fluosilicate.
Insol. in pure, sol. in acidified H_2O. (Berzelius.)

Zinc fluosilicate, $ZnSiF_6+6H_2O$.
Very easily sol. in H_2O. (Berzelius.)

Zirconium fluosilicate.
Sol. in H_2O. Solution clouds up on boiling. (Berzelius.)

Fluostannic acid.

Ammonium fluostannate, $(NH_4)_2SnF_6$.
Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 224.)
$4NH_4F$, SnF_4. Sol. in H_2O. (Marignac.)

Barium fluostannate, $BaSnF_6$.
Slowly sol. in H_2O.
$+3H_2O$. Sol. in 18 pts. H_2O at 18°. (Marignac, Ann. Min. (5) **15.** 246.)

Calcium fluostannate, $CaSnF_6+2H_2O$.
Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 250.)

Cadmium fluostannate, $CdSnF_6+6H_2O$.
Sol. in H_2O. (Marignac.)

Cupric fluostannate, $CuSnF_6+4H_2O$.
Not deliquescent. (Marignac, Ann. Min. (5) **15.** 291.)

Lithium fluostannate, $Li_2SnF_6+2H_2O$.
Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 242.)

Magnesium fluostannate, $MgSnF_6+6H_2O$.
Not deliquescent. Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 256.)

Manganous fluostannate, $MnSnF_6+6H_2O$.
Slowly efflorescent. (Marignac.)

Nickel fluostannate, $NiSnF_6+6H_2O$.
Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 262.)

Potassium fluostannate, $K_2SnF_6+H_2O$.
Two modifications—(a) *Thin plates.* Sol. in 2·3 pts. H_2O at 100°, and in 15-16 pts. at 18°. (Marignac.)
(b) *Octahedra.* Sol. in 3 pts. H_2O at 100°, and 27 pts. at 18°. (Marignac.)

Potassium hydrogen fluostannate, $3KF$, HF, SnF_4.
Sol. in H_2O. (Marignac.)

Silver fluostannate, $Ag_2SnF_6+4H_2O$.
Sl. deliquescent. Easily sol. in H_2O. (Marignac.)

Sodium fluostannate, Na_2SnF_6.
Sol. in 18-19 pts. H_2O at 20°. (Marignac.)

Strontium fluostannate, $SrSnF_6+2H_2O$.
Sol. in 5·5 pts. H_2O at 18°. (Marignac.)

Zinc fluostannate, $ZnSnF_6+6H_2O$.
Sol. in H_2O. (Marignac.)

Fluosulphonic acid, HSO_3F.

See **Sulphuryl hydroxyl fluoride.**

Fluotantalic acid.

Ammonium fluotantalate, $(NH_4)_2TaF_7$.
Very sol. in H_2O. (Marignac, A. ch. (4) **9.** 272.)

Calcium fluotantalate.
Difficultly sol. in H_2O (Berzelius.)

Cupric fluotantalate, $CuTaF_7+4H_2O$.
Deliquescent. Easily sol. in H_2O. (Marignac, A. ch. (4) **9.** 294.)

Lead fluotantalate.
Difficultly sol. in H_2O. (Berzelius.)

Potassium fluotantalate, K_2TaF_7.
Sl. sol. in cold, much more easily in hot H_2O. Decomposes, with formation of a white precipitate on boiling. (Berzelius.)
Much more sol. in $HF+Aq$. 1 pt. of the salt is sol. in 200 pts. H_2O containing a trace of HF, and in 150-160 pts. of H_2O containing a little more HF. (Marignac, A. ch. (4) **9.** 267.)

Potassium hydrogen fluotantalate, KF, HF, TaF_5 (?).
Sol. in H_2O. (Berzelius.)

Sodium fluotantalate, $3NaF$, TaF_5.
Easily sol. in H_2O.
$Na_2TaF_7+H_2O$. Sol. in H_2O. (Marignac.)

Zinc fluotantalate, $ZnTaF_7+7H_2O$.
Very deliquescent. Sol. in H_2O. (Marignac, A. ch. (4) **9.** 249.)

Fluotelluric acid.

Ammonium fluotellurate, $NH_4TeF_5+H_2O$.
Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Barium fluotellurate, $Ba(TeF_5)_2+H_2O$.
As above.

Potassium fluotellurate, $KTeF_5$.
As above.

Fluotitanic acid.

Known only in solution as titanium hydrogen fluoride.

Ammonium fluotitanate, $(NH_4)_2TiF_6$.
Sol. in H_2O. (Marignac.)
$3NH_4F$, TiF_4. Sol. in H_2O. (Marignac.)

Ammonium fluo*sequis*titanate, $6NH_4F$, Ti_2F_6.
Easily sol. in H_2O. Sl. sol. in NH_4F+Aq. (Petersen, J. pr. (2) **40.** 54.)

Insol. in NH_4F+Aq. (Piccini, C. R. **97.** 1064.)

$4NH_4F, Ti_2F_6$. Properties as the corresponding K salt. (Piccini, B. **18.** 257 R.)

Calcium fluotitanate, $CaTiF_6+3H_2O$.

Decomp. by pure H_2O. Sol. without decomp. in acidified H_2O. (Berzelius.)

Separates a precipitate with cold H_2O, which dissolves on heating. (Marignac, Ann. Min. (5) **15.** 250.)

Cupric fluotitanate, $CuTiF_6+4H_2O$.

Sol. in pure H_2O with partial decomp.; easily and completely sol. in acidified H_2O. (Berzelius.)

Cupric fluotitanate ammonium fluoride, $CuTiF_6, NH_4F+4H_2O$.

Efflorescent. Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 267.)

Cupric fluotitanate potassium fluoride, $CuTiF_6, KF+4H_2O$.

As the above salt. (Marignac.)

Ferrous fluotitanate, $FeTiF_6+6H_2O$.

Sol. in H_2O. (Weber, Pogg. **120.** 287.)

Ferric fluotitanate.

Decomp. by H_2O. (Berzelius.)

Lead fluotitanate.

Easily sol. in H_2O. (Berzelius.)

Magnesium fluotitanate, $MgTiF_6+6H_2O$.

Easily sol. in cold H_2O. (Marignac, Ann. Min. (5) **15.** 257.)

Nickel fluotitanate, $NiTiF_6+6H_2O$.

Easily sol. in H_2O. (Weber, Pogg. **120.** 282.)

Potassium fluotitanate, $K_2TiF_6+H_2O$.

Difficultly sol. in cold, much more easily in hot H_2O.

100 pts. H_2O dissolve at:

0°	3°	6°	10°	14°	20°	
0·556	0·667	0·775	0·909	1·042	1·28	pts. K_2TiF_6.

(Marignac, A. ch. (4) **8.** 65.)

Potassium fluo*sesqui***titanate,** $4KF, Ti_2F_6$.

Scarcely sol. in H_2O; sol. in dil. acids. (Piccini, B. **18.** 257 R.)

Silver fluotitanate.

Very deliquescent. (Marignac.)

Sodium fluotitanate, Na_2TiF_6.

Much more sol. in H_2O than the corresponding potassium salt. (Marignac, Ann. Min. (5) **15.** 238.)

Sodium hydrogen fluotitanate, $Na_2TiF_6+NaHF_2$.

Sol. in H_2O. (Marignac.)

Strontium fluotitanate, $SrTiF_6+2H_2O$.

Sol. in cold H_2O. Solution clouds up on heating. (Marignac.)

Zinc fluotitanate, $ZnTiF_6+6H_2O$.

Sol. in H_2O. (Marignac, A. ch. (3) **60.** 304.)

Fluovanadic acid.

Ammonium fluovanadate, $3NH_4F, VF_3$.

Moderately sol. in H_2O. More easily sol. in dil. acids. Nearly insol. in alcohol or MF+Aq. (Petersen, J. pr. (2) **40.** 52.)

$2NH_4F, VF_3+H_2O$. Easily sol. in H_2O. Sl. sol. in alcohol. (Petersen.)

NH_4F, VF_3+2H_2O. As above. (Petersen.)

Cadmium fluovanadate, CdF_2, VF_3+7H_2O.

Very sl. sol. in H_2O. (Piccini and Giorgis, Gazz. ch. it. **22, 1.** 89.)

Cobalt fluovanadate, CoF_2, VF_3+2H_2O.

Sol. in H_2O without decomp. (Petersen, *l.c.*)

Nickel fluovanadate, NiF_2, VF_3+2H_2O.

As the Co salt. (Petersen.)

Potassium fluovanadate, $2KF, VF_3+H_2O$.

Sl. sol. in H_2O; easily sol. in acids. Insol. in KF+Aq. (Petersen, J. pr. (2) **40.** 51.)

Potassium fluovanadate fluoxyvanadate, $4KF, VF_3, VOF_3$.

Easily sol. in H_2O, and still more easily in HF+Aq. Sl. sol. in KF+Aq. (Petersen, J. pr. (2) **40.** 274.)

Sodium fluovanadate, $5NaF, 2VF_3+H_2O$.

As the potassium salt. (Petersen.)

Zinc fluovanadate, ZnF_2, VF_3+7H_2O.

Sl. sol. in cold H_2O. Decomp. on heating. (Piccini and Giorgis.)

Fluoxycolumbic acid.

Ammonium fluoxycolumbate, $3NH_4F, CbOF_3$.

Cubic salt. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 38.)

$2NH_4F, CbOF_3$. *Lamellar salt.* Much more sol. in H_2O than $2KF, CbOF_3$. (M.)

$5NH_4F, 3CbOF_3+H_2O$. *Hexagonal salt.* (M.)

$NH_4F, CbOF_3$. *Rectangular salt.* (M.)

Ammonium fluoxycolumbate columbium fluoride, $3NH_4F, CbOF_3, CbF_5$.

(Marignac.)

Cupric fluoxycolumbate, $CuF_2, CbOF_3+4H_2O$.

Sl. deliquescent. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 42.)

Potassium fluoxycolumbate, $2KF, CbOF_3+H_2O$.

Sol. in 12·5-13 pts. H_2O at 17-21°. Much more sol. in hot H_2O, or H_2O containing HF. (Marignac.)

$3KF, CbOF_3$. Decomp. by H_2O into above salt. (M.)

$5KF, 3CbOF_3+H_2O$. Sol. in H_2O. (M.)

$4KF, 3CbOF_3+2H_2O$. Sol. in H_2O. (M.)

$3KF, 2Cb_2O_5+5H_2O$. Sl. sol. in H_2O. (Petersen, J. pr. (2) **40.** 287.)

$KF, Cb_2O_5+3H_2O$. Sl. sol. in H_2O. (Petersen.)

$2KF, 3CbO_2F$. Insol. in H_2O. Sol. in HF. (Krüss and Nilson, B. **20.** 1689.)

See also **Fluoxypercolumbate, potassium.**

Potassium hydrogen fluoxycolumbate, $3KF, HF, CbOF_3$.

Sol. in H_2O. (Marignac.)

Sodium fluoxycolumbate, $2NaF, CbOF_3+2H_2O$.

Sol. in H_2O.

$NaF, CbOF_3+H_2O$. (Marignac.)

Zinc fluoxycolumbate, $ZnF_2, CbOF_3+6H_2O$.

Sol. in H_2O. (Marignac, A. ch. (4) **8.** 41.)

Fluoxyhypomolybdic acid.

Ammonium fluoxyhypomolybdate, $MoOF_3, 2NH_4F$.

Decomp. by H_2O. (Mauro, Gazz. ch. it. **19.** 179.)

$3MoOF_3, 5NH_4F+H_2O$. Decomp. by H_2O. (Mauro.)

Cupric fluoxyhypomolybdate, $CuF_2, MoOF_3+4H_2O$.

Deliquescent. Sol. in H_2O. (Mauro, Real. Ac. Linc. **1892, 1.** 194.)

Potassium fluoxyhypomolybdate, $MoOF_3, 2KF+H_2O$.

Sol. in H_2O with decomp.

Sol. in HF or HCl+Aq. (Mauro and Panabianco, Gazz. ch. it. **12.** 80.)

$3MoOF_3, 5KF+H_2O$. Sol. in H_2O with decomp. (Mauro, Gazz. ch. it. **19.** 179.)

Zinc fluoxyhypomolybdate, $ZnF_2, MoOF_3+6H_2O$.

Rapidly deliquescent. Sol. in H_2O. (Mauro, Real. Ac. Linc. **1892, 1.** 194.)

Fluoxyhypovanadic acid.

See **Fluoxyvanadic acid.**

Fluoxymanganic acid.

Ammonium fluoxymanganate, $(NH_4)_2MnOF_4$.

Precipitate. (Nicklès.)

Potassium fluoxymanganate, K_2MnOF_4.

Precipitate. (Nicklès, C. R. **65.** 107.)

*Sesqui*fluoxymanganic acid.

Potassium *sesqui*fluoxymanganate, $K_4Mn_2OF_8=4KF, Mn_2OF_4$.

Precipitate. (Nicklès.)

Fluoxymolybdic acid.

See also **Fluoxyhypomolybdic,** *and* **fluoxypermolybdic acids.**

Ammonium fluoxymolybdate, NH_4F, MoO_2F_2.

Sol. in H_2O. (Mauro, Gazz. ch. it. **20.** 109.)

$+H_2O$. More sol. in H_2O than $2NH_4F, MoO_2F_2$. (Delafontaine, N. Arch. Sci. ph. nat. **30.** 250.)

Correct formula is $3NH_4F, MoO_2F_2$. (Mauro, Gazz. ch. it. **18.** 120.)

$2NH_4F, MoO_2F_2$. Much more sol. than $2KF, MoO_2F_2$. (Delafontaine.)

$3NH_4F, MoO_2F_2$. Sol. in H_2O. (Mauro.)

$5NH_4F, 3MoO_2F_2+H_2O$. Sol. in H_2O. (Mauro, Gazz. ch. it. **20.** 109.)

Ammonium fluoxymolybdate molybdate, $MoO_2F_2, 4NH_4F, (NH_4)_2MoO_4$.

Sol. in H_2O, but with decomp. (Mauro, Gazz. ch. it. **18.** 120.)

Cadmium fluoxymolybdate, $CdF_2, MoO_2F_2+6H_2O$.

Sl. efflorescent. (Delafontaine, J. B. **1867.** 236.)

Cobaltous fluoxymolybdate, $CoF_2, MoO_2F_2+6H_2O$.

Sol. in H_2O. (Delafontaine, J. B. **1867.** 236.)

Cupric fluoxymolybdate, $CuF_2, MoO_2F_2+4H_2O$.

Deliquescent. (Mauro, Real. Ac. Linc. **1892, 1.** 194.

Nickel fluoxymolybdate, $NiF_2, MoO_2F_2+6H_2O$.

Sol. in H_2O. (Delafontaine, J. B. **1867.** 236.)

Potassium fluoxymolybdate, $2KF, MoO_2F_2+H_2O$.

Easily sol. in boiling H_2O.

$KF, MoO_2F_2+H_2O$. Gradually efflorescent. (Delafontaine.)

$MoO_3F_2, 2KF+H_2O$. "Fluoxypermolybdate." Sl. sol. in cold, easily in hot H_2O. (Piccini, Real. Ac. Linc. **7, 1.** 267.)

Rubidium fluoxymolybdate, $2RbF, 2MoO_2F_2+2H_2O$.

Sol. in cold, more sol. in hot H_2O. (Delafontaine.)

Sodium fluoxymolybdate, $NaF, MoO_2F_2+\frac{1}{2}H_2O$.

Sol. in H_2O. (Delafontaine.)

Thallous fluoxymolybdate, $2TlF, MoO_2F_2+H_2O$.

Sol. in hot H_2O. (Delafontaine.)

Zinc fluoxymolybdate, $ZnF_2, MoO_2F_2+6H_2O$.

Sol. in H_2O. (Delafontaine.)

Fluoxypercolumbic acid.

Potassium fluoxypercolumbate, $2KF, CbO_2F_3+H_2O$.

(Piccini, Z. anorg. **2.** 21.)

Fluoxypermolybdic acid.

Ammonium fluoxypermolybdate, $MoO_3F_2, 3NH_4F$.

Sol. in H_2O. (Piccini, Z. anorg. **1.** 51.)

Cæsium fluoxypermolybdate, $MoO_3F_2, 2CsF+H_2O$. (Piccini.)

Potassium fluoxypermolybdate, $MoO_3F_2, 2KF+H_2O$.

Not very sol. in H_2O; more sol. in HF+Aq without decomp. (Piccini.)

Rubidium fluoxypermolybdate, $MoO_3F_2, 2RbF+H_2O$.

Somewhat more sol. in H_2O than K salt. Easily sol. in HF+Aq. (Piccini.)

Fluoxypertantalic acid.

Potassium fluoxypertantalate, $2KF, TaO_2F_3 + H_2O$.

Sol. in H_2O. (Piccini, Z. anorg. **2.** 21.)

Fluoxypertitanic acid, $TiO_2F_2, 2HF$.

Known only in solution. (Piccini, B. **18.** 255 R.)

Ammonium fluoxypertitanate, $TiO_2F_2, 2NH_4F$.

Very unstable. (Piccini, Gazz. ch. it. **17.** 479.)

$TiO_2F_2, 3NH_4F$. Sol. in H_2O.

$2TiO_2F_2, 3NH_4F$. Sol. in H_2O. (Piccini, B. **18.** 698 R.)

Barium fluoxypertitanate, TiO_2F_2, BaF_2.

Precipitate. Easily sol. in acids. (Piccini, B. **18.** 698 R.)

$2TiO_2F_2, 3BaF_2$. Insol. in H_2O; sol. in dil. acids. (Piccini, Gazz. ch. it. **17.** 479.)

Potassium fluoxypertitanate, $TiO_2F_2, 2KF$.

Sol. in H_2O. (Piccini, B. **21.** 1391.)

Fluoxypertungstic acid.

Potassium fluoxypertungstate, $2KF, WO_3F + H_2O$.

(Piccini, Z. anorg. **2.** 11.)

Fluoxytantalic acid.

See also **Fluoxypertantalic acid.**

Ammonium fluoxytantalate, $3NH_4F, TaOF_2$.

Easily sol. in H_2O. The solution clouds up by standing or on warming. (Joly, C. R. **81.** 1266.)

Fluoxytitanic acid.

See also **Fluoxypertitanic acid.**

Barium fluoxytitanate, $TiOF_2, BaF_2$.

Insol. in H_2O; sol. in dil. acids. (Piccini, Gazz. ch. it. **17.** 479.)

Fluoxytungstic acid.

Ammonium fluoxytungstate, $2NH_4F, WO_2F_2$.

Very sol. in H_2O. (Marignac, A. ch. (3) **69.** 65.)

$NH_4F, WO_2F_2 + H_2O$. Decomp. by H_2O. Crystallises unchanged from H_2O containing HF. (Marignac.)

Ammonium fluoxytungstate tungstate, $4NH_4F, WO_2F_2, (NH_4)_2WO_4$.

Incompletely sol. in H_2O. Residue dissolves in $NH_4OH + Aq$. (Marignac.)

Cadmium fluoxytungstate.

Very sol. in H_2O. (Marignac.)

Cupric fluoxytungstate, $CuF_2, WO_2F_2 + 4H_2O$.

Very sol. in H_2O. (Marignac, C. R. **55.** 888.)

Cupric fluoxytungstate ammonium fluoride, $CuF_2, WO_2F_2, NH_4F + 4H_2O$.

Sol. in H_2O. (Marignac.)

Manganese fluoxytungstate.

Very sol. in H_2O. (Marignac.)

Nickel fluoxytungstate, $NiF_2, WO_2F_2 + 10H_2O$.

Deliquescent. Very sol. in H_2O. (Marignac.)

Potassium fluoxytungstate, $KF, WO_2F_2 + H_2O$.

Can be recrystallised without decomp. only from H_2O containing HF. (Marignac, A. ch. (3) **69.** 70.)

$2KF, WO_2F_2 + H_2O$. Difficultly sol. in cold, more easily in hot H_2O. (Berzelius.)

Sol. in 17 pts. H_2O at 15°. (Marignac.)

Can be recrystallised without decomp. from H_2O, or H_2O containing HF. (Marignac.)

See also **Fluoxypertungstate, potassium.**

Silver fluoxytungstate.

Very easily sol. in H_2O. (Marignac.)

Sodium fluoxytungstate, $2NaF, WO_2F_2$.

More sol. in H_2O than the corresponding K compound. (Berzelius.)

Zinc fluoxytungstate, $ZnF_2, WO_2F_2 + 10H_2O$.

Very sol. in H_2O. (Marignac.)

Fluoxyuranic acid.

Ammonium fluoxyuranate, $3NH_4F, UO_2F_2$.

Easily sol. in H_2O, less in HF. Insol. in alcohol. (Bolton.)

Barium fluoxyuranate, $3BaF_2, 2UO_2F_2 + 2H_2O$.

Traces dissolve in hot H_2O. Easily sol. in dil. acids. (Bolton.)

Potassium fluoxyuranate, $3KF, UO_2F_2$.

Sol. in 8 pts. H_2O at 21°. Insol. in alcohol and ether. (Bolton, J. pr. **99.** 269.)

Does not exist. (Smithells, Chem. Soc. **43.** 125.)

$4KF, UO_2F_2$. Insol. in H_2O. Easily sol. in dil. acids. (Ditte, C. R. **91.** 115.)

$5KF, 2UO_2F_2$. (Baker, Chem. Soc. **35.** 760.)

$3KF, 2UO_2F_2 + 2H_2O$. (Baker.)

Sodium fluoxyuranate, NaF, UO_2F_2.

$+ 2H_2O$. Not efflorescent.

$+ 4H_2O$. Insol. in H_2O and dil. acids. Sl. sol. in conc. $HCl + Aq$. Sol. in conc. H_2SO_4. (Bolton, J. B. **1866.** 212.)

$4NaF, UO_2F_2$. (Ditte.)

Does not exist. (Smithells, Chem. Soc. **43.** 125.)

Fluoxyvanadic acid.

Ammonium fluoxyvanadate, $12NH_4F, V_2O_5, 2VOF_3$.

Easily sol. in H_2O, and not attacked by cold conc. H_2SO_4. (Baker, Chem. Soc. **33.** 388.)

Formula is $3NH_4F, VO_2F$. (Petersen, J. pr. (2) **40.** 289.)

$3NH_4F, VO_2F$. Sol. in H_2O. (Petersen, *l.c.*)

Much less sol. in H_2O in presence of NH_4F. (Piccini and Giorgis, Gazz. ch. it. **27,** **1.** 65.)

$3NH_4F, VOF_2$. "Hypovanadate." Quite sol. in H_2O. Very sl. sol. in $MF + Aq$. Less sol. in alcohol than in H_2O. (Petersen, J. pr. (2) **40.** 195.)

$2NH_4F, VOF_2$. Sol. in H_2O. (Petersen.)

$+ H_2O$. (Piccini and Giorgis.)

$7NH_4F$, $4VOF_2+5H_2O$. Very sol. in H_2O. (Petersen.)

$3NH_4F$, $2VO_2F$. Sol. in H_2O without decomp. Sol. in conc. HF+Aq. (Piccini and Giorgis, Gazz. ch. it. **24**, **1**. 68.)

$3NH_4F$, $2VOF_3+H_2O$. Sol. in H_2O with decomp.

V_2O_5, $2NH_4F$. (Ditte, C. R. **106**. 270.)

V_2O_5, $8NH_4F+4H_2O$. As above.

V_2O_5, $4NH_4F+4H_2O$. As above. Sol. in H_2O.

Ammonium hydrogen flu*di*oxyvanadate, $7NH_4F$, HF, $4VO_2F$.

Very sol. in H_2O. (Petersen, J. pr. (2) **40**. 284.)

Ammonium hydrogen *tri*fluoxyvanadate, 3HF, $9NH_4F$, $5VOF_3$.

Easily sol. in H_2O. Sl. sol. in MF+Aq. (Petersen, J. pr. (2) **40**. 280.)

$3NH_4F$, 3HF, $2VOF_3$. Sol. in H_2O. (Baker, Chem. Soc. **33**. 388.)

Identical with 3HF, $9NH_4F$, $5VOF_3$. (Petersen.)

Cadmium fluoxyvanadate, CdF_2, VOF_2+7H_2O.

"Hypovanadate." As Zn salt. (Piccini and Giorgis.)

Cobalt fluoxyvanadate, CoF_2, VOF_2+7H_2O.

"Hypovanadate." Sol. in H_2O. (Piccini and Giorgis.)

Nickel fluoxyvanadate, NiF_2, VOF_2+7H_2O.

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

Potassium fluoxyvanadate, 7KF, $3VOF_2$.

Very sl. sol. in H_2O and MF+Aq. Easily sol. in dil. acids. (Petersen, J. pr. (2) **40**. 199.)

2KF, VOF_2. As above. (Petersen.)

2KF, $2V_2O_5+8H_2O$. Sol. in H_2O and H_2SO_4. (Ditte, C. R. **105**. 1067.)

2KF, $3V_2O_5+5H_2O$. As above.

2KF, $4V_2O_5+8H_2O$. As above.

4KF, V_2O_5. Less sol. than 4KF, $3V_2O_5$. $+2H_2O$, and $+3H_2O$. Sol. in H_2O.

4KF, $3V_2O_5+4H_2O$, and $+6H_2O$. Less sol. than 2KF, $3V_2O_5+5H_2O$.

8KF, $V_2O_5+2H_2O$, and $+3H_2O$. Sol. in H_2O.

Potassium *tri*fluoxyvanadate, 2KF, VOF_3.

Ppt. (Petersen, J. pr. (2) **40**. 272.)

6KF, V_2O_5, $2VOF_3+2H_2O$. Sol. in H_2O. Insol. in cold conc. H_2SO_4. (Baker, Chem. Soc. **33**. 300.)

Formula is 3KF, $2VO_2F$. (Piccini and Giorgis.)

See also **Fluovanadate fluoxyvanadate, potassium.**

Potassium flu*di*oxyvanadate, 2KF, VO_2F.

Easily sol. in H_2O. (Petersen, J. pr. (2) **40**. 278.)

3KF, VO_2F. As above. (Petersen.)

3KF, $2VO_2F$. Sol. in H_2O; scarcely attacked by H_2SO_4. (Piccini and Giorgis.)

Potassium hydrogen fluoxyvanadate, 3KF, HF, $2VOF_3$.

Sol. in H_2O. (Petersen.)

Sodium fluoxyvanadate, 8NaF, $3VOF_2+2H_2O$.

Sol. in H_2O. (Petersen, J. pr. (2) **40**. 200.)

3NaF, VO_2F, VOF_3 (?). Very easily decomp. (Piccini and Giorgis.)

2NaF, $2V_2O_5+10H_2O$. Sol. in H_2O. (Ditte, C. R. **106**. 270.)

4NaF, V_2O_5. As above.

4NaF, $3V_2O_5+18H_2O$. As above.

6NaF, $V_2O_5+5H_2O$. As above.

8NaF, $V_2O_5+3H_2O$. As above.

Zinc fluoxyvanadate, ZnF_2, ZnO, $2VOF_3+14H_2O$.

Decomp. on air; sol. in H_2O. (Baker, Chem. Soc. **33**. 388.)

True composition is represented by the formula ZnF_2, VO_2F+7H_2O. (Petersen.)

ZnF_2, VO_2F+7H_2O. Very sol. in H_2O. (Piccini and Giorgis.)

ZnF_2, VOF_2+7H_2O. "Hypovanadate." Sol. in cold H_2O, but decomp. by boiling; sol. in dil. HF+Aq. (Piccini and Giorgis.)

Fluozirconic acid.

Ammonium fluozirconate, $(NH_4)_2ZrF_6$.

Sol. in H_2O.

$3NH_4F$, ZrF_4. Sol. in H_2O. (Marignac.)

Cadmium fluozirconate, $2CdF_2$, ZrF_4+6H_2O.

Sol. in H_2O; can be recrystallised therefrom. (Marignac, A. ch. (3) **60**. 257.)

$CdZrF_6+6H_2O$. Sol. in H_2O. (Marignac.)

Cupric fluozirconate, $2CuF_2$, ZrF_4+12H_2O.

Easily sol. in cold H_2O. (Marignac, A. ch. (3) **60**. 296.)

$3CuF_2$, $2ZrF_4+16H_2O$. Sol. in H_2O. (Marignac.)

Magnesium fluozirconate, $MgZrF_6+5H_2O$.

Sol. in H_2O. (Marignac.)

Manganous fluozirconate, $MnZrF_6+5H_2O$.

Sol. in H_2O. (Marignac, J. pr. **83**. 202.)

Nickel fluozirconate, $2NiF_2$, ZrF_4+12H_2O.

Sol. in H_2O. (Marignac, A. ch. (3) **60**. 291.)

$NiZrF_6+6H_2O$. Sol. in H_2O. (Marignac.)

Nickel potassium fluozirconate, K_2ZrF_6, $NiZrF_6+8H_2O$.

Sol. in H_2O. (Marignac.)

Potassium fluozirconate, KF, ZrF_4+H_2O.

Much more sol. in hot, than cold H_2O. (Marignac.)

2KF, $ZrF_4=K_2ZrF_6$. 100 pts. H_2O dissolve at 2°, 0·781 pt.; at 15°, 1·41 pts.; at 19°, 1·69 pts.; at 100°, 25·0 pts. K_2ZrF_6. (Marignac.)

3KF, ZrF_4.

Sodium fluozirconate, 5NaF, ZrF_4.

100 pts. H_2O dissolve 0·387 pt. at 18°, and 1·67 pts. at 100°. (Marignac.)

Zinc fluozirconate, $ZnZrF_6 + 6H_2O$.

Sol. in H_2O. (Marignac.)

$2ZnF_2$, $ZrF_4 + 12H_2O$. Sol. in H_2O. (Marignac, A. ch. (3) **60.** 257.)

Fulminating gold.

See **Auroamidoimide.**

Fulminating platinum.

See **Fulminoplatinum.**

Fulminating silver.

See **Silver nitride.**

Fulminoplatinum compounds.

See—
***Di*chlorofulminoplatinum.**
***Tri*chlorofulminoplatinum.**
***Tetra*chlorofulminoplatinum.**
Chloroxyfulminoplatinum.

Fuscocobaltic chloride, $Co(NH_3)_4(OH)Cl_2 + H_2O$.

Sol. in H_2O, from which it is precipitated by $NH_4Cl + Aq$; decomp. by boiling H_2O; pptd. from aqueous solution by alcohol. (Fremy, C. R. **32.** 501.)

—— **nitrate,** $Co(NH_3)_4(OH)(NO_3)_2 + H_2O$.

Sol. in H_2O. Properties as the chloride. (Fremy.)

—— **sulphate,** $Co(NH_3)_4(OH)SO_4 + 1\frac{1}{2}H_2O$.

Sol. in H_2O. Insol. in $NH_4OH + Aq$. (Fremy, C. R. **32.** 501.)

Insol. in H_2O. Sol. in conc. $HCl + Aq$, or H_2SO_4, from which it is precipitated by H_2O. (Vortmann, M. **6.** 412.)

Fusible white precipitate.

See **Mercuri*di*ammonium chloride.**

Gadolinium, Gd (?).

(Marignac, C. R. **102.** 92.)

Gadolinium oxide, Gd_2O_3 (?).

Sol. in acids. (de Boisbaudran, C. R. **111.** 394.)

Gallium, Ga.

Not decomp. by H_2O; easily sol. in cold $HCl + Aq$. Slowly sol. in warm dil. $HNO_3 + Aq$. Not attacked by conc. HNO_3 free from N_2O_3 below 40-50°, and only slowly in presence of N_2O_3. (Dupré, C. R. **86.** 720.)

Easily sol. in cold or warm $KOH + Aq$. (de Boisbaudran, A. ch. (5) **10.** 100.)

Gallium bromide, $GaBr_3$.

Deliquescent, and sol. in H_2O.

Gallium *di*chloride, $GaCl_2$.

Deliquescent, and decomp. by H_2O. (Nilson and Petersen, C. R. **107.** 527.)

Gallium chloride, $GaCl_3$.

Deliquescent, and very sol. in little H_2O. Decomp. by much H_2O, with formation of basic salt, which is slowly sol. in dil. $HCl + Aq$.

Gallium hydroxide.

Sol. in acids; sol. in KOH or $NaOH + Aq$, less easily in $NH_4OH + Aq$, even in presence of ammonium salts.

Gallium iodide, GaI_3.

Deliquescent, and sol. in H_2O. (de Boisbaudran and Jungfleisch, C. R. **86.** 578.)

Gallium *sub*oxide, GaO (?).

Sol. in $HNO_3 + Aq$. (Dupré.)

Sol. in dil. $H_2SO_4 + Aq$.

Gallium oxide, Ga_2O_3.

Sol. in acids.

Germanium, Ge.

Insol. in $HCl + Aq$. Easily sol. in aqua regia. Decomp. by $HNO_3 + Aq$ to oxide. Conc. H_2SO_4 decomp. to sulphate. Insol. in boiling $KOH + Aq$. (Winkler, J. pr. (2) **34.** 177; **36.** 177.)

Germanium *tetra*bromide, $GeBr_4$.

Decomp. by H_3O. (Winkler.)

Germanium *di*chloride, $GeCl_2$.

Decomp. by H_2O. (Winkler.)

Germanium *tetra*chloride, $GeCl_4$.

Sinks in H_2O, and is gradually decomp. thereby. (Winkler, J. pr. **34.** 177.)

Insol. in and not attacked by hot conc. H_2SO_4. (Friedrich, W. A. B. **102, 2b.** 540.)

Germanium chloroform, $GeHCl_3$.

Decomp. by H_2O. Sol. in $HCl + Aq$. (Winkler.)

Germanium *tetra*fluoride, GeF_4.

Deliquescent, and sol. in H_2O.

$+3H_2O$. Deliquescent. Melts in its crystal H_2O when warmed. (Winkler.)

Germanium potassium fluoride.

See **Fluogermanate, potassium.**

Germanium *tetra*iodide, GeI_4.

Deliquescent, and sol. in H_2O with decomp. (Winkler.)

Germanium *mon*oxide, GeO.

Not appreciably sol. in dil. $H_2SO_4 + Aq$. Easily sol. in $HCl + Aq$. Insol. in alkalies. (Winkler, J. pr. (2) **34.** 177.)

Somewhat sol. in H_2O; insol. in $H_2SO_4 + Aq$, even when hot and conc. (van Bemmelen, R. t. c. **6.** 205.)

Germanium *di*oxide, GeO_2.

Not very difficultly sol. in H_2O.

Sol. in 247·1 pts. H_2O at 20°; in 93·3 pts. at 100°. (Winkler.)

Easily sol. in alkali carbonates or hydrates + Aq; sl. sol. in acids.

Germanium oxychloride, $GeOCl_2$.

Insol. in H_2O; sol. in acids. (Winkler, J. pr. (2) **36.** 177.)

Germanium *mono*sulphide, GeS.

Sol. in 402·9 pts. H_2O. Sol. in conc. hot

HCl+Aq. Sol. in KOH+Aq. Sol. in $(NH_4)_2S$+Aq when precipitated. Insol. in $(NH_4)_2S$+Aq if crystalline. Also exists in a colloidal state. (Winkler.)

Germanium *di*sulphide, GeS_2.

Sol. in 221·9 pts. H_2O. Easily sol. in KOH+Aq, or NH_4OH+Aq. Insol. in acids. Exists also in a colloidal state. (Winkler.)

Glass.

Numerous and extensive researches have been made on the action of H_2O and various solutions on glass. The older work has a certain historical interest, but only a brief statement of some of the more important results can be given here. For a very thorough résumé of the work before the year 1861, Storer's Dictionary, p. 555, should be consulted.

All glass is more or less attacked by H_2O, the more easily the greater the amount of alkali present, the finer it is powdered, and the higher the temperature.

Glass, as that of a flask, is decomposed to a considerable extent by several days' boiling with H_2O, a portion of the fixed alkali being dissolved, but when powdered glass is rubbed with distilled H_2O in a mortar, the H_2O remains pure and exhibits no alkalinity. (Scheele.)

Glass of alembics is partially dissolved by long boiling with H_2O. (Lavoisier.)

H_2O extracts potash or soda from glass together with a portion of the silica, the decomposition taking place the more easily in proportion as the glass is richer in alkalies, more minutely divided, or the temperature of the water higher. (Bischof, Kastn. Arch. **1.** 443.)

Powdered crown glass and some varieties of window glass render cold H_2O alkaline when in contact therewith. (Dumas.)

100 pts. finely divided flint glass lose 7 pts. potash when boiled one week with H_2O. (Griffiths, Q. J. Sci. **20.** 258.)

Retorts of ordinary or flint glass are partially dissolved by H_2O when it is evaporated therein. (Chevreul, **1811.**)

Finely powdered plate-glass (Faraday, Pogg. **18.** 569), and Thuringian potash glass (Ludwig, Arch. Pharm. **91.** 47) redden moistened turmeric paper.

The alkaline reaction disappears by continued washing, but reappears when the glass is freshly rubbed. (Griffiths.)

Cold H_2O takes up SiO_2 as well as alkali from glass powder. (Fuchs.)

Powdered lead glass gives up appreciable amounts of PbO to weakly acidified H_2O. (Pelouze.)

When powdered white glass, containing 12·4 % Na_2O, 15·5 % CaO, and 72·1 % SiO_2, is treated repeatedly with H_2O, more than 3 % of the glass is dissolved, and the undissolved part gives up 1·5 % CaO to HCl+Aq with effervescence. A glass containing more alkali, *i.e.* 16·3 % Na_2O, 6·4 % CaO, 77·3 % SiO_2, lost with the same treatment 18·2 %, and the residue gave up 2 % CaO to HCl+Aq. (Pelouze, C. R. **43.** 117.)

In the above case the fineness of the glass has an influence as well as its composition. When the same sample of glass was boiled 1 hour with H_2O, amounts were dissolved in the proportion 1 : 4 : 28, according as the glass was in the form of a coarse, fine, or very fine powder. Glass of the composition of the above samples, as given by Pelouze, lost 10 and 32 % respectively.

If powdered glass is boiled with H_2O and CO_2 conducted into the solution, it is absorbed; if boiled with K_2SO_4, Na_2SO_4 is dissolved. (Pelouze.)

Glass tubes are converted into a white crystalline mass by heating with H_2O several months to 75-150°; lead glass and Bohemian glass most easily, English crown glass least. A little H_2O attacks glass more than much H_2O.

The action of H_2O is greatly increased by finely pulverising the glass. H_2O dissolved 10 % of a glass containing 12 % Na_2O, 15·5 % CaO, and 72·5 % SiO_2, and 32 % of another glass containing 16·3 % Na_2O, 6·4 % CaO, and 77·3 % SiO_2. (Vogel, B. A. München, **1867.** 437.)

Action of H_2O on a glass containing 74 % SiO_2, 8·6 % CaO, 14 % Na_2O, 0·6 % K_2O, with traces of Al_2O_3, Fe_2O_3, MnO, and MgO.

By boiling with H_2O a decrease of 3·9 mg. was observed for the first hour, which soon became constant at 2·2 mg. per hour. The action was then proportional to the time, and also to the surface in contact with the liquid, but independent of the amount of liquid evaporating.

The action decreases rapidly with the temperature, so that at 90-100° only ¼ as much glass is dissolved as by boiling H_2O. (Emmerling, A. **150.** 257.)

When steam condenses in tubes of Na glass, they are so strongly attacked that the H_2O has an alkaline reaction, but tubes of hard or Bohemian K glass are not so strongly attacked. (Tollens, B. **9.** 1540.)

The effect of H_2O is so great as to impart a distinctly alkaline reaction to water condensing in a tube of ordinary glass. By condensing water in long tubes of various kinds of glass the following results were obtained.

I. Easily fusible Thuringian glass. Surface exposed = 324 sq. cm.

After 2 hours, 62·0 mg. KOH were dissolved.

After 3 hours more, 36·0 mg. KOH were dissolved.

After 3 hours more, 33·2 mg. KOH were dissolved.

After 3 hours more, 20·8 mg. KOH were dissolved.

After 3 hours more, 20·8 mg. KOH were dissolved.

Or, in 14 hours, 172·8 mg. KOH were dissolved.

II. Less easily fusible Thuringian glass. Surface exposed = 499 sq. cm.

After 3 hours, 19·2 mg. KOH were dissolved.

After 3 hours more, 15·2 mg. KOH were dissolved.

After 3 hours more, 12·4 mg. KOH were dissolved.

After 3 hours more, 11·2 mg. KOH were dissolved.

Or, after 12 hours, 58·0 mg. KOH were dissolved.

III. Combustion tubing of very difficultly fusible Bohemian glass. Surface exposed = 1130 sq. cm.

After 3 hours 4·16 mg. KOH were dissolved.

After 3 hours more 4·16 mg. KOH were dissolved.

After 3 hours more 4·16 mg. KOH were dissolved.

After 3 hours more 4·16 mg. KOH were dissolved.

Or, after 12 hours, 16·64 mg. KOH were dissolved.

IV. Easily fusible Bohemian glass. Surface exposed = 1394 sq. cm.

After 3 hours, 7·88 mg. KOH were dissolved.

After 3 hours more, 8·56 mg. KOH were dissolved.

After 3 hours more, 1·97 mg. KOH were dissolved.

Or, after 9 hours, 24·32 mg. KOH were dissolved. (Kreusler and Henzold, B. **17**. 34.)

From the above the following table has been calculated.

50 ccm. H_2O dissolves from a surface of 1000 sq. m. in 1 hour :—

96·0 mg. from easily fusible Thuringian glass.

12·8 mg. from less fusible Thuringian glass.

1·2 mg. from combustion tube of Bohemian glass.

2·0 mg. from harder tube of Bohemian glass.

(Kreusler and Henzold, B. **17**. 34.)

100 ccm. H_2O dissolves so much glass from a flask every 2 seconds when in contact therewith that 0·1 ccm. $\frac{1}{10}$ normal oxalic acid is neutralised thereby. (Bohlig, Z. anal. **23**. 518.)

Action of H_2O on various kinds of Na glass. 1 g. of finely powdered glass was boiled 10-15 minutes in a silver dish with 100 ccm. H_2O, and the per cent of Na_2O (or K_2O) in the solution was determined.

	% Na_2O (K_2O)
Orthoclase felspar	0·17
Glass of a Bohemian combustion tube	0·56
,, flask (German manuf.)	0·69
,, champagne bottle	1·7
Natrolite	1·32
Glass of a wine bottle (Hungarian)	2·22
Glass which was attacked by H_2O under pressure	3·7
Lead glass	3·8
Glass that broke easily	4·8
Glass tubing that became rough when fused	6·1
Glass tubing that became opaque by fusing	14·35
Solid water glass	26·97

(Wartha, Z. anal. **24**. 220.)

The relative ease by which various kinds of glass are attacked by H_2O is shown by the following table. The glass was powdered and heated on a water bath with exclusion of atmospheric CO_2.

Potassium water glass	291
Sodium water glass	196
Yellow glass rich in alkali	34
Thuringian glass	19
Ditto from Tittel and Co.	8
Window glass	8
Lead glass from Jena	6
Bohemian glass from Kavalier	2·4
Lead crystal glass	1·4
Thermometer glass, 16IV, from Jena	1·0
Zinc glass, 362, from Jena	0·8
Lead glass, 434, from Jena	0·6
Lead glass, 483, from Jena	0·2
Heaviest lead silicate, from Jena	0·0

(Mylius, C. C. **1888**. 1313.)

Solubility of various kinds of glass in H_2O. The amounts dissolved from various kinds of glass by heating 5 hours with H_2O were as follows.

Yellow glass rich in alkali (13 % K_2O, 15 % Na_2O)	249 mg.
Poor Thuringian glass (6·6 % K_2O, 16·5 % Na_2O)	91·4 ,,
Glass from Tittel and Co. (7·1 % K_2O, 14·3 % Na_2O)	30·4 ,,
Bottle glass from Schilling (4·2 % K_2O, 11·9 % Na_2O)	13·0 ,,
Bohemian glass from Kavalier (13·3 % K_2O, 11·4 % Na_2O)	10·1 ,,
Rhenish window glass (13·5 % Na_2O)	8·4 ,,
Lead crystal glass from Ehrenfeld (12·1 % K_2O)	8·5 ,,
Green bottle glass (1·3 % K_2O, 9·5 % Na_2O)	6·5 ,,
Thermometer glass 16III from Jena (14·0 % Na_2O, 7 % ZnO)	6·4 ,,
Lead glass, No. 483, from Jena (47 % PbO, 7·3 % K_2O)	3·3 ,,
Lead silicate	0·6 ,,

(Mylius and Förster, B. **22**. 1100.)

By calculation from the electrical conductivity of the solutions formed, various data were obtained by Kohlrausch (B. **24**. 3561), which showed that different varieties of glass were attacked in very different degree by cold H_2O, and, moreover, the amount dissolved was proportionately much greater during the first few minutes of treatment with H_2O than afterwards, and, furthermore, the rate of decrease was much faster for good glass than poor. Increase of temperature increased the rate of solubility to a very great degree, the increase for 1° C. being about 17 %. In 7 hours at 80° half as much was dissolved as in 6 months at 18°. Extensive tables are given. (Kohlrausch, B. **24**. 3561.) See also Kohlrausch (W. Ann. **44**. 577).

A very extensive research on the action of H_2O on glass, with a historical review of the work previously done on the subject, has been published by Mylius and Förster. (Z. anal. **31**. 241.) The general results may be summed up as follows :—

1. The solution of glass in H_2O is caused by a decomposition, by which free alkali is formed.
2. The silicic acid of the glass is brought into solution by a secondary reaction of the free alkali in the solution.
3. The constituents of the solution change according to the conditions of the digestion.
4. The amount of alkali going into solution from a given surface under certain conditions is a measure for the resistance of a glass under those conditions.
5. The rate of attack of glass surfaces by cold H_2O decreases rapidly with the length of time of digestion, and finally approaches a constant value.
6. The solubility increases very rapidly with increase of temperature.

7. The ratio of the solubility of several kinds of glass is dependent on the temperature.

8. From glasses which show the same ease of attack unequal amounts of substance may be dissolved.

9. The solubility of a glass is influenced by the condition of the surface from "weathering" by prolonged exposure to the CO_2 and H_2O of the air.

10. The poorer a glass is the less will its solubility decrease by prolonged treatment with H_2O.

11. A good glass is essentially less easily attacked after having been previously treated with H_2O.

12. After treatment with H_2O, glass surfaces have the property of fixing alkali from the solutions formed, and giving it up again by a subsequent treatment with H_2O.

13. Potassium glass is much more sol. than sodium glass (contrary to previous researches), but the difference decreases as the glass becomes richer in CaO.

14. In glass flasks which are to be only slightly attacked by cold or hot H_2O, the CaO, alkalies, and SiO_2 must stand in a fixed relation to each other.

15. Of the more common varieties of glass, lead flint glass is least sol. in H_2O, but its surface is corroded, and it is easily decomp. by acids.

(Mylius and Förster, Z. anal. **31.** 241.)

Bottle glass containing much Al_2O_3 is easily attacked by acids.

From powdered flint glass, boiling HCl+Aq extracts K, but no Pb. (Griffiths.)

Bottles of flint glass with $(NH_4)_2CO_3$+Aq became so fragile that on shaking pieces of glass were detached. (Griffiths.)

All glass is decomp. by HF.

Conc. H_3PO_4 also attacks all glass.

Glass containing small amounts of SiO_2 are attacked by H_2SO_4; poorer glass by boiling HCl, HNO_3, and aqua regia. (Berzelius.)

Conc. HNO_3 does not act on flint glass at 145-150°. (Sorby, C. R. **50.** 990.)

Glass of ordinary chemical apparatus gives up traces of metals to HCl and HNO_3+Aq, but hard Bohemian glass consisting of 75 % SiO_2, 15 % K_2O, 10 % CaO, resists the action of warm conc. acids; also an easily fusible Na K glass with 77 % SiO_2, 7·7 % K_2O, 5 % Na_2O, 10·3 % CaO, is not easily attacked. (Stas.)

KOH, and NaOH+Aq dissolve SiO_2 from glass the more easily the hotter and the more conc. the solutions are. (Müller.) NH_4OH, and $(NH_4)_2CO_3$+Aq attack many kinds of glass, especially flint glass. CaO_2H_2 attacks glass appreciably at 45° and lower; still more strongly on boiling. (Lamy, A. ch. (5) **14.** 155.)

The action of various solvents on the glass mentioned on page 168 in Emmerling's experiments is as follows:

The action of HCl+Aq containing 0·2 to 3 % HCl is practically null, but is increased either by dilution or concentration. A very small quantity (0·02 %) HCl added to H_2O almost wholly prevents its action on glass. With HCl+Aq (11 % HCl) a decrease of 4·2 mg. was noticed in the first hour, and only 3-4 mg. afterwards. The same is the case for HNO_3+Aq in still greater degree, 0·008 % HNO_3 sufficing to nearly counteract the solvent action of H_2O.

H_2SO_4+Aq has about double the solvent effect possessed by H_2O.

Oxalic and acetic acids both diminish the solvent action of H_2O.

The addition of even traces (0·04 %) of Na_2CO_3 increases the solvent action, and this is further rapidly increased by an increase in the amount of Na_2CO_3. Na_2CO_3+Aq containing 1 % Na_2CO_3 dissolves about 10 times as much as pure H_2O, *i.e.* about 35 mg. per hour.

The above is also the case with KOH+Aq, but in even greater degree. KOH+Aq containing 0·025 % KOH dissolved three times as much as pure H_2O.

$(NH_4)_2CO_3$+Aq has about the same action as H_2O.

With NH_4OH+Aq (9 % NH_3) 7 mg. decrease for the first hour, and 3 mg. afterwards was noticed. The concentration of the NH_4OH+Aq was apparently without effect.

The addition of NH_4Cl decreases the solvent action of H_2O proportionately to the amount added, but with new flasks large amounts are dissolved.

With NH_4Cl+Aq (7 % NH_4Cl) 4·2 mg. were dissolved in the first hour, and the amount dissolved gradually decreased to null after 24 hours on account of the liberation of HCl by the decomp. of NH_4Cl.

NaCl, KCl, KNO_3, and Na_2SO_4 show a similar behaviour to that of NH_4Cl.

Na_2HPO_4+Aq containing 0·4 % Na_2HPO_4 has six times the solvent action of pure H_2O, but the action is not increased by further concentration.

In general, those salts the acids of which form insol. Ca salts, as Na_2CO_3, Na_2SO_4, Na_2HPO_4, $(NH_4)_2C_2O_4$, increase the solvent action of H_2O, and this effect is greater the more concentrated the solution. KCl, KNO_3, NH_4Cl, and $CaCl_2$ decrease the effect, and the stronger the solution the less is the action.

All Na glass with approximately the above composition has the same power of resistance against H_2O; Bohemian K glass shows a greater resistance, especially against acids. (Emmerling, A. **150.** 257.)

Action of various reagents on hard Bohemian glass. 100 ccm. substance dissolved mg. glass in 6 days at 100°.

H_2O	10·0
H_2S+Aq . . .	8·7
Dil. $(NH_4)_2S$+Aq . .	52·5
Conc. $(NH_4)_2S$+Aq .	47·2
Conc. NH_4OH+Aq .	42·5
Dil. NH_4OH+Aq . .	7·7
NH_4SH+Aq . . .	51·2

(Cowper, Chem. Soc. **41.** 254.)

Action of various solutions on glass of different composition. (The figures denote decrease in weight in mg. of a 100 ccm. flask.)

	Time	1	2	3	4	5	6	7	8	9	10
H_2O	5 hrs.	62	31	29	17	13	9	7	7	5	4
H_2SO_4+Aq (25 % H_2SO_4) .	3 ,,	...	43	35	8	7	6	5	5	5	3
HCl+Aq (12 % HCl) . .	3 ,,	85	...	27	4	2	1	1	1	0	0
NH_4OH+Aq (10 % NH_3) .	3 ,,	...	...	62	11	8	7	7	6	5	5
Na_2HPO_4+Aq (12 % Na_2HPO_4)	3 ,,	...	...	81	64	40	35	34	30	15	12
Na_2CO_3+Aq (2 % Na_2CO_3) .	3 ,,	283	160	130	124	50	45	42	42	26	25

Composition of above varieties of glass.

	1	2	3	4	5	6	7	8	9	10
SiO_2 . .	76·22	74·09	76·39	68·56	74·48	74·69	66·75	74·12	77·07	74·40
Al_2O_3 .	...	0·40	0·50	1·85	0·50	0·45	1·31	0·50	0·30	0·70
CaO . .	4·27	5·85	5·50	7·60	7·15	7·85	13·37	8·55	8·10	8·85
K_2O . .	...	7·32	4·94	2·24	6·64	8·64	15·50	4·86	3·75	4·40
Na_2O. .	19·51	12·34	12·67	19·75	11·23	8·37	3·07	11·97	10·78	11·65

It is seen that glass which resists the attack of H_2O also resists acids and alkalies, and that the relative resistance of all varieties to any of the solutions is the same. Therefore the action of H_2O may be accepted as a criterion for judging of the resistance of a glass to all solvents. Glass No. 10, in which the molecular ratio of SiO_2:CaO:K_2O(Na_2O) is 8 : 1 : 1·5, is recommended as best suited for chemical uses. (Weber and Sauer, B. **25.** 70.)

Mylius and Förster (B. **25.** 97) recommend a glass in which the molecular ratio of SiO_2 : CaO : K_2O (Na_2O) is 7·2 : 1 : 1·1 as the best suited for chemical apparatus.

In an exhaustive research on the action of aqueous solutions on glass, which cannot be given in full on account of its great length, the following conclusions are reached :—

1. Solutions of caustic alkalies act on glass much more strongly than H_2O, dissolving all the constituents of the glass—that is, the glass as such. Very dilute solutions form an exception.

2. Of the caustic alkalies, NaOH+Aq has the strongest action, then come KOH, NH_4OH, and BaO_2H_2+Aq in the order named.

3. Increase in temperature increases the strength of the attack of alkalies very considerably.

4. At high temperatures, the ease with which glass is attacked increases at first rapidly with the concentration of the alkali, but afterwards more slowly. .

5. At ordinary temperatures very concentrated alkali solutions have less action on glass than dil. solutions.

6. Solutions of pure alkalies, if not too conc., act less on glass than when contaminated with small amounts of SiO_2.

7. Alkali carbonates+Aq attack glass much more than H_2O, even when they are very dilute. The action corresponds less to that of the caustic alkalies than to that of other salts. With equivalent concentration, Na_2CO_3+Aq has a stronger action than K_2CO_3+Aq.

8. The action of salt solutions on glass is a compound one, depending both on the concentration and the kind of salt dissolved, and is made up of the action of the H_2O and the salt in solution.

9. Each kind of attack is differently influenced by the composition of the glass.

10. Solutions of those salts, the acids of which form insol. Ca salts, have a stronger action than H_2O, and the action increases with the concentration.

11. Solutions of those salts, the acids of which form sol. Ca salts, have less action than H_2O, and the action decreases with the concentration. (Förster, B. **25.** 2494.)

Glucinic acid.

Potassium glucinate, K_2GlO_2.

Very deliquescent. Sol. in H_2O and acids. (Krüss and Moraht, B. **23.** 733.)

Glucinum (Beryllium), Gl.

Not attacked by hot or cold H_2O. Sol. in cold dil. HNO_3+Aq. (Wöhler, Pogg. **13.** 577.)

Sol. only in boiling conc. HNO_3+Aq. (Debray, A. ch. (3) **44.** 5.)

Sol. in dil. HCl+Aq, dil. and conc. H_2SO_4+Aq, and KOH+Aq, but insol. in NH_4OH+Aq. (Wöhler, Debray.)

Glucinum bromide, $GlBr_2$.

Sol. in H_2O with evolution of much heat. (Wöhler.)

Glucinum chloride, $GlCl_2$.

Anhydrous. Fumes and deliquesces in air. Sol. in H_2O with hissing and evolution of much heat. Easily sol. in alcohol.

$+4H_2O$. Deliquescent, and very sol. in H_2O.

Glucinum ferric chloride, $GlCl_2$, $FeCl_3+H_2O$.

Decomp. by H_2O. (Neumann, A. **244.** 329.)

Glucinum mercuric chloride, $GlCl_2$, $3HgCl_2+6H_2O$.

Sol. in H_2O. (Atterberg, B. **6.** 1288.)

Glucinum thallic chloride, $3GlCl_2$, $2TlCl_3$.

Cryst. from HCl solution. (Neumann, A. **244.** 348.)

Glucinum stannic chloride.

See **Chlorostannate, glucinum.**

Glucinum fluoride.

Not known in solid state.

Glucinum potassium fluoride, GlF_2, KF.

Sl. sol. in H_2O. (Awdejew.) Much more sol. in hot than cold H_2O. (Berzelius.)

GlF_2, 2KF. Sol. in about 50 pts. H_2O at 20°, and 19 pts. boiling H_2O. (Marignac.)

Glucinum sodium fluoride, GlF_2, 2NaF.

Sol. in 34 pts. H_2O at 100°, and 68 pts. at 18°. (Marignac.)

Glucinum hydroxide, GlO_2H_2.

Easily sol. in acids. Sol. in H_2SO_3+Aq.

Sol. in CO_2+Aq; 100 ccm. sat. CO_2+Aq dissolve 0·0185 g. GlO. (Sestini, Gazz. ch. it. **20.** 313.)

Also sol. in KOH, NaOH, NH_4OH, or $(NH_4)_2CO_3+Aq$, especially when first precipitated; also in Na_2CO_3, or K_2CO_3+Aq. (Debray.)

Insol. in NH_4OH+Aq containing NH_4Cl+Aq.

Very sl. sol. in Li_2CO_3+Aq. (Gmelin.)

Sol. in H_2SO_3+Aq. (Berthier.)

Sol. in BaO_2H_2+Aq, from which it is pptd. by NH_4 salts, but not by boiling. Sol. in boiling NH_4Cl+Aq when freshly pptd.

Sol. in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 130.)

Contains $\frac{1}{3}H_2O$ (Schaffgotsch); $\frac{4}{3}H_2O$ (Atterberg).

Glucinum iodide, GlI_2.

Sol. in H_2O with evolution of much heat. (Wöhler.)

Glucinum oxide, GlO.

Crystalline. Insol. in acids except conc. H_2SO_4. (Ebelmen, C. R. **32.** 710.)

Amorphous. Absolutely insol. in H_2O. The higher the temp. to which the substance has been heated the more insol. is it in acids. Insol. in NH_4OH+Aq or $(NH_4)_2CO_3+Aq$. Insol. in conc. NH_4Cl+Aq or KOH, and $NaOH+Aq$. (Rose.)

When obtained by ignition of $GlSO_4$, it is very slowly but completely sol. in HCl, and H_2SO_4+Aq. (Rose.)

Glucinum oxybromides.

Sol. in H_2O if three or less equivalents of base are present to one of acid; insol. if more of the base is present. (Ordway, Am. J. Sci. (2) **26.** 207.)

Glucinum oxychloride, $Gl_2OCl_2=GlO$, $GlCl_2$.

Insol. in H_2O.

$3GlCl_2$, $2GlO+2H_2O$ (?). Sol. in H_2O. (Atterberg.)

$GlCl_2$, $3GlO+3H_2O$ (?). Sol. in H_2O, but solution soon becomes cloudy and deposits a fine ppt. By boiling the solution it is decomp. into above salt, and $GlCl_2$, $12GlO_2H_2+10H_2O$, which is insol. in H_2O; decomp. into GlO_2H_2 by washing. Sol. in acids. (Atterberg.)

Glucinum phosphide.

Decomp. by H_2O. (Wöhler.)

Glucinum selenide.

Sl. sol. in H_2O. (Berzelius.)

Glucinum sulphide.

Slowly sol. without decomp. in H_2O, but easily decomp. by acids. (Wöhler.)

Gold, Au.

Not attacked by H_2O. Insol. in HNO_3 or $HCl+Aq$. Easily sol. in aqua regia or any mixture evolving Cl or Br. Sol. in selenic acid, or antimonic acid + Aq; less easily in arsenic acid + Aq. Sol. in mixtures of HCl and nitrates, or HNO_3 and chlorides; also in $(NaCl + KNO_3 + K_2Al_2(SO_4)_4) + Aq$ (?). Insol. in H_2SO_4, except in presence of $KMnO_4$, HNO_3, or HIO_3. Sol. in a solution of I in ether in direct sunlight.

Sol. in solutions of ferric, and cupric salts.

Sol. in $HCl+Aq$ containing H_2CrO_4, H_2MnO_4, H_2SeO_4, H_3AsO_4, or $FeCl_3$. (Wurtz.)

In finely divided state Au is sol. in boiling $KCN+Aq$. Not attacked by boiling $HgCl_2+Aq$. (Vogel, J. pr. **20.** 366.)

Sol. in cold Na_2S+Aq when Na_2S is present in proportion of 843 pts. Na_2S to 1 pt. Au. (Becker, Sill. Am. J. (3) **33.** 199.)

Easily sol. in nitrosulphonic acid from sulphuric acid manufacture, when mixed with equal parts conc. $HCl+Aq$. (Bornträger, Rep. anal. Ch. **1887.** 741.)

Sol. in PCl_3. (Baudrimont, A. ch. (4) **2.** 416.)

Gold arsenide, AuAs.

H_2O or alcohol slowly extracts As; HNO_3+Aq converts into Au and H_3AsO_4. Sol. in aqua regia. Not attacked by cold, decomp. by hot conc. H_2SO_4. (Tivoli, C. C. **1887.** 778; J. B. **1887.** 610.)

Gold bismuthide, Au_2Bi.

Min. *Maldonite.* Sol. in aqua regia.

Aurous bromide, AuBr.

Insol. in H_2O. (Thomsen, C. C. **1860.** 606.)

Auroauric bromide, Au_2Br_4.

Not deliquescent. H_2O or ether dissolves out $AuBr_3$. (Thomsen, C. C. **1860.** 606.)

Does not exist. (Krüss, B. **20.** 640.)

Existence is maintained by Petersen. (J. pr. (2) **46.** 334.)

Auric bromide, $AuBr_3$.

Not deliquescent. Slowly sol. in H_2O, more readily in ether.

Aurous phosphorus *tri*bromide, AuBr, PBr_3.

Decomp. by H_2O. (Lindet, J. pr. (2) **32.** 494.)

Auric phosphorus *penta*bromide, $AuBr_3$, PBr_5.

Decomp. by H_2O. (Lindet.)

Aurous bromide phosphorus *tri*chloride, $AuBr, PCl_3$.

Decomp. by H_2O. (Lindet.)

Aurous chloride, $AuCl$.

Insol. in H_2O, but gradually decomp. thereby into Au and $AuCl_3$. (Thomsen, J. pr. (2) **13.** 341.)

Auric chloride, $AuCl_3$.

Deliquescent. Very sol. in H_2O. Sol. in 1·47 pts. H_2O. (Abl.) Sol. in conc. HCl, or HNO_3+Aq without decomp.

$AsCl_3$ dissolves about 22 % at 160° and 2·5 % at 15°. Solubility in $SbCl_3$ is about the same. Much less sol. in $SnCl_4$ or $TiCl_4$, $SnCl_4$ dissolving 4 % at 160° and hardly a trace at 0°. Very sl. sol. in hot or cold $SiCl_4$. (Lindet, Bull. Soc. (2) **45.** 149.)

Sol. in alcohol with gradual decomp. (Gmelin.) Sol. in ether with decomp. in light or on long standing. Ether extracts $AuCl_3$ from $AuCl_3+Aq$ (Proust). Sol. in volatile oils with gradual decomp.

$+2H_2O$. (Thomsen.)

Auroauric chloride, Au_2Cl_4.

Decomp. by H_2O into $AuCl_3$ and AuCl. (Thomsen, J. pr. (2) **13.** 357.)

Does not exist. (Krüss and Schmidt, J. pr. (2) **38.** 77.)

Existence is maintained by Christensen. (J. pr. (2) **46.** 328.)

Auric chloride *with* MCl.

See **Chloraurate, M.**

Auric nitrosyl chloride, $AuCl_3, NOCl$.

Sol. in H_2O with decomp. (Sudborough, Chem. Soc. **59.** 662.)

Aurous phosphorus *tri*chloride, $AuCl, PCl_3$.

Decomp. by H_2O. Sol. in about 100 pts. PCl_3 at 15°, and about 8 pts. at 120°. Sol. in $AsCl_3$. (Lindet, C. R. **101.** 1492.)

Auric phosphorus *penta*chloride, $AuCl_3, PCl_5$.

Decomp. by H_2O. Nearly insol. in PCl_3. Sol. in $AsCl_3$. (Lindet.)

Aurous potassium chloride, $AuCl, KCl$.

Decomp. by H_2O or $HCl+Aq$ into KCl, $KAuCl_4$, and Au. (Berzelius.)

Auric potassium chloride.

See **Chloraurate, potassium.**

Auric selenium chloride, $AuCl_3, SeCl_4$.

Decomp. by H_2O. Sol. in $AsCl_3$. (Lindet, C. R. **101.** 1492.)

Aurous sodium chloride, $AuCl, NaCl$.

Insol. in H_2O. Sol. in alcohol. (Meillet, J. Pharm. **3.** 447.)

Formula is $4NaCl, AuCl, AuCl_3$. (Jörgensen.)

Auric sodium chloride.

See **Chloraurate, sodium.**

Auric sulphur chloride, $AuCl_3, SCl_4$.

Easily decomp. by H_2O. (Lindet, C. R. **101.** 1492.)

Auric hydroxide, AuO_3H_3.

Nearly insol. in most acids. Easily sol. in very conc. HNO_3+Aq (Proust), from which all AuO_3H_3 is separated by dilution (Fremy). Extremely sl. sol. in fuming HNO_3. Sol. in dil. HNO_3+Aq when pure (Krüss, A. **237.** 281). Not attacked by H_3PO_4. Insol. in HF. Sol. in HCl, or $HBr+Aq$ (Fremy).

Sol. in H_2SeO_4+Aq. (Mitscherlich.)

Sl. sol. in conc. H_2SO_4; somewhat sol. in $HC_2H_3O_2+Aq$. (Rose.)

Nearly insol. in cold $KOH+Aq$, but dissolved on boiling. Insol. in NH_4OH+Aq or alkali carbonates + Aq (Rose). Sl. sol. in boiling $CaCl_2+Aq$, $NaCl+Aq$, $BaCl_2+Aq$ (Pelletier). Sol. in NH_4CN, and $KCN+Aq$ (Himly).

Sl. sol. in KCl, or $NaCl+Aq$. (Pelletier.)

$AuO, OH=Au_2O_3, H_2O$. (Krüss.)

Auroauric hydroxide, $Au_3O_2(OH)_2=3Au_2O_2+2H_2O$.

Insol. in boiling conc. $KOH+Aq$. Decomp. by conc. HCl or HNO_3+Aq into Au and Au_2O_3, which dissolves. (Schöttlander, A. **217.** 336.)

Aurous iodide, AuI.

Insol. in cold, decomp. by hot H_2O, H_2SO_4, HCl, or HNO_3+Aq, with separation of Au. Decomp. immediately by ether, more slowly by alcohol.

Partially sol. in KI, FeI_3, or $HI+Aq$ (Pelletier). Sl. attacked by NH_4OH, or $NaCl+Aq$ at 35° (Fordos). Instantly decomp. by $KOH+Aq$.

Auric iodide, AuI_3.

Insol. in H_2O. Sol. in alkali iodides, and $HI+Aq$. Decomp. on air or by alkalies. (Johnston, Phil. Mag. J. **9.** 266.)

Aurous oxide, Au_2O.

Insol. in H_2O or alcohol. Decomp. by boiling with $HCl+Aq$ into Au and $AuCl_3$. H_2SO_4, HNO_3, or $HC_2H_3O_2+Aq$ do not attack. Sol. in cold aqua regia. Sol. in $HI+Aq$. Sol. in KOH, or $NaOH+Aq$ when freshly precipitated. (Berzelius.)

According to Krüss (A. **237.** 281) all hitherto prepared Au_2O is impure. Pure Au_2O is sol. in cold H_2O when freshly precipitated, from which hydroxide is precipitated by boiling. Partly sol. in HCl, or $HBr+Aq$. Sol. in KOH, or $NaOH+Aq$ when freshly precipitated. Not affected by any other acid or solvent. (Krüss.)

Auric oxide, Au_2O_3.

See **Auric hydroxide.**

Auroauric oxide, Au_2O_2.

Sol. in cold $HCl+Aq$; forms insol. comp. with HF. (Prat, C. R. **70.** 842.)

Obtained pure by Krüss (A. **237.** 296).

Gold phosphide, Au_4P_6.

Not attacked by $HCl+Aq$. HNO_3 forms H_3PO_4 and leaves undissolved Au. (Schrötter, J. B. **1849.** 247.)

AuP. Decomp. on air or with H_2O. (Cavazzi, Gazz. ch. it. **15.** 40.)

Gold purple (mixture of Au and SnO_2).

Insol. in H_2O. Easily sol. in aqua regia.

HCl+Aq dissolves all Sn and leaves Au.

Boiling HNO_3+Aq dissolves a little Sn.

Insol. in boiling KOH+Aq (Berzelius). KOH+Aq extracts excess of SnO_2, and the residue becomes sol. in H_2O, from which it is pptd. by NH_4Cl+Aq. (Figuier, A. ch. (3) **11.** 353.)

Sol., when still moist, in NH_4OH+Aq, but insol. if it has been dried.

Obtained in colloidal state in aqueous solution containing 0·58 g. Au and 5·41 g. SnO_2 in a litre. This solution may be concentrated without coagulation. The solution is coagulated by dil. HNO_3, or HCl+Aq, more easily by dil. H_2SO_4 + Aq ; also by KCl, $HgCl_2$, $FeSO_4$ + Aq, and many other salts. Not coagulated by alcohol, but easily when ether is added to the alcohol. (Schneider, Z. anorg. **5.** 80.)

Gold selenide, Au_2Se_3.

HNO_3+Aq dissolves out Se. Sol. in aqua regia or alkali sulphides +Aq. (Uelsmann, J. B. **1860.** 90.)

Aurous sulphide, Au_2S.

Easily sol. in H_2O when freshly prepared, but precipitated from aqueous solution by HCl, KCl, or NaCl+Aq. When dried is insol. in H_2O.

Insol. in boiling dil. or conc. HCl, or H_2SO_4+Aq. Easily sol. in aqua regia, HCl+Aq with $KClO_3$, etc. Slowly sol. in alkali monosulphides +Aq. Easily sol. in polysulphides +Aq.

Insol. in KOH+Aq. Sol. in KCN+Aq. (Krüss, B. **20.** 2369.)

Known also in colloidal state in aqueous solution containing 1·74 g. Au_2S per l. (Schneider, B. **24.** 2241.)

Auroauric sulphide, Au_2S_2.

Insol. in H_2O or acids except aqua regia. Sl. sol. in cold alkali monosulphides +Aq, but easily sol. on warming. Sol. in cold polysulphides +Aq, but less in ammonium polysulphide than the other alkali polysulphides.

Not attacked by cold, but easily sol. in hot KOH+Aq. Sol. in KCN+Aq. (Hoffmann and Krüss, B. **20.** 2704.)

Obtained also in colloidal state in aqueous solution containing 0·8 g. per l. (Schneider.)

Auric sulphide, Au_2S_3.

Insol. in H_2O and acids except aqua regia ; sol. in alkali sulphides, or KOH+Aq. (Berzelius.)

Does not exist (Krüss, B. **22.** 2369), but has since been made by Antony and Luchesi (Gazz. ch. it. **20.** 601). Insol. in HCl, or dil. HNO_3+Aq. Decomp. by conc. HNO_3, KOH, or NaOH+Aq with separation of Au. Sl. decomp. by NH_4OH+Aq. Easily sol. in KCN+Aq ; decomp. by $(NH_4)_2S$+Aq. Sol. in cold Na_2S or K_2S+Aq ; decomp. on boiling. (Antony and Luchesi, Gazz. ch. it. **21,** **2.** 209.)

Gold sodium sulphide, $NaAuS+4H_2O$.

Sol. in H_2O and alcohol. (Yorke, Chem. Soc. Q. J. **1.** 236.)

Gold telluride.

Ppt. (Berzelius, Pogg. **8.** 178.)

Gold silver telluride, Au_2Te_2, Ag_2Te.

Min. *Sylvanite.* Sol. in HNO_3+Aq with separation of Au, in aqua regia with separation of AgCl.

$3Ag_2Te$, Au_2Te. Min. *Petzite.*

Hartshorn, salts of.

See **Carbonate carbamate, ammonium hydrogen.**

Hexamine chromium compounds.

See **Luteochromium compounds.**

Hexamine cobaltic compounds, $Co_2(NH_3)_6X_6$.

See **Dichrocobaltic compounds.**

$Co(NH_3)_6X_3$.

See **Luteocobaltic compounds.**

Hexamine iridium chloride, $Ir_2(NH_3)_6Cl_6$.

See **Irido*tri*amine chloride.**

Hexathionic acid, $H_2S_6O_6$.

Known only in aqueous solution, which decomposes rapidly, even in presence of free sulphuric acid. (Debus, A. **244.** 76.)

Potassium hexathionate, $K_2S_6O_4$.

Sol. in H_2O, with rapid decomp. Not obtained in pure state. (Debus, A. **244.** 76.)

Holmium, Ho (?).

Holmium oxide, Ho_2O_3.

(Cleve, C. R. **89.** 478 ; **91.** 328.)

Consists of at least two elements. (Lecoq de Boisbaudran, C. R. **102.** 1005.)

Consists of seven elements. (Krüss and Nilson.)

*Sesqui*hydraurylamine, $(AuOH)_3N, NH_3 = Au_3N_2+3H_2O$.

Decomp. by boiling with H_2O. (Raschig, A. **235.** 341.)

Hydrazine, $N_2H_4=NH_2—NH_2$.

Very sol. in H_2O. (Curtius, B. **20.** 1632.)

Has not been isolated, and known only as hydroxide $N_2H_4OH_2$. (Curtius, J. pr. **39.** 27.)

Hydrazine azoimide, N_2H_4, HN_3.

Deliquescent. Easily sol. in H_2O. Sl. sol. in alcohol, and can be crystallised therefrom. (Curtius, B. **24.** 2344.)

Hydrazine carbonate.

Very deliquescent, but only sl. sol. in H_2O. (Curtius and Jay.)

Hydrazine *mono*hydrobromide, N_2H_4, HBr.

Very easily sol. in H_2O or hot alcohol. (Curtius and Schulz, J. pr. (2) **42.** 537.)

Hydrazine *di*hydrobromide, N_2H_4, 2HBr.

Easily sol. in H_2O. Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 535.)

Hydrazine *mono*hydrochloride, N_2H_4, HCl.

Extremely sol. in H_2O. Sl. sol. in boiling absolute alcohol. (Curtius and Jay, J. pr. (2) **39.** 38.)

Hydrazine *di*hydrochloride, N_2H_4, 2HCl.

Easily sol. in cold H_2O; sl. sol. in hot alcohol. (Curtius, *l.c.*)

Nearly insol. in hot absolute alcohol. (Curtius and Jay, J. pr. (2) **39.** 37.)

Hydrazine *di*hydrofluoride, N_2H_4, 2HF.

Easily sol. in H_2O. Nearly insol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 533.)

Hydrazine *mono*hydroiodide, N_2H_4, HI.

Easily sol. in H_2O. (Curtius and Schulz.)

Hydrazine *di*hydroiodide, N_2H_4, 2HI.

Very deliquescent. Easily sol. in H_2O. Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 536.)

***Tri*hydrazine *di*hydroiodide,** $3N_2H_4$, 2HI.

Easily sol. in H_2O and alcohol. (Curtius and Schulz, J. pr. (2) **42.** 540.)

Hydrazine hydroxide, N_2H_4, H_2O.

Miscible with H_2O or alcohol, but not with ether, chloroform, or benzene. (Curtius and Schulz, J. pr. (2) **42.** 530.)

Hydrazine nitrate.

Very sol. in H_2O. (Curtius and Jay.)

Hydrazine oxalate.

Less sol. than acetate or formiate.

Hydrazine sulphate, N_2H_4, H_2SO_4.

Sol. with difficulty in cold, easily in hot H_2O. Insol. in alcohol. (Curtius, *l.c.*)

100 pts. H_2O dissolve 3·055 pts. salt at 22°. (Curtius and Jay, J. pr. (2) **39.** 39.)

$2N_2H_4$, H_2SO_4. Very deliquescent, and sol. in H_2O. Insol. in alcohol. (Curtius, J. pr. (2) **44.** 101.)

Hydriodic acid, HI.

See **Iodhydric acid.**

Hydrobromic acid, HBr.

See **Bromhydric acid.**

Hydrochloric acid, HCl.

See **Chlorhydric acid.**

Hydrofluorboric acid. HBF_4.

See **Fluoborhydric acid.**

Hydrofluoric acid, HF.

See **Fluorhydric acid.**

Hydrogen, H_2.

Sl. absorbed by H_2O.

Sol. in 150 pts. H_2O; 1 vol. H_2O absorbs 0·016 vol. H. Recently boiled H_2O absorbs 1·53 % H. (Henry, 1803.)

100 vols. H_2O at 18° absorb 4·6 vols. H. (de Saussure, 1814.)

1 vol. H_2O absorbs 0·0193 vol. H at 760 mm. and all temperatures between 0° and 23·6°. (Bunsen.)

Later work does not confirm the above statement.

Absorption of H by H_2O at t° and 760 mm. β=coefficient of absorption; β_1="solubility" (see under Oxygen).

t°	β	β_1
0	0·02153	0·02140
1	0·02134	0·02120
2	0·02115	0·02100
3	0·02097	0·02081
4	0·02079	0·02062
5	0·02061	0·02043
6	0·02044	0·02025
7	0·02027	0·02007
8	0·02010	0·01989
9	0·01994	0·01971
10	0·01978	0·01954
11	0·01962	0·01937
12	0·01947	0·01920
13	0·01932	0·01904
14	0·01918	0·01888
15	0·01903	0·01872
16	0·01889	0·01856
17	0·01876	0·01840
18	0·01863	0·01825
19	0·01850	0·01810
20	0·01837	0·01795
21	0·01825	0·01781
22	0·01813	0·01767
23	0·01802	0·01753
24	0·01791	0·01739
25	0·01780	0·01725
26	0·01770	0·01712

(Timofejeff, Z. phys. Ch. **6.** 147.)

Absorption of H by H_2O at t° and 760 mm. β=coefficient of absorption.

t°	β	t°	β	t°	β
0	0·0203	16	0·0182	32	0·0161
1	0·0202	17	0·0180	33	0·0160
2	0·0200	18	0·0179	34	0·0159
3	0·0199	19	0·0178	35	0·0157
4	0·0198	20	0·0177	36	0·0156
5	0·0196	21	0·0175	37	0·0155
6	0·0195	22	0·0174	38	0·0154
7	0·0194	23	0·0172	39	0·0153
8	0·0192	24	0·0171	40	0·0152
9	0·0191	25	0·0170	45	0·0149
10	0·0190	26	0·0168	50	0·0146
11	0·0189	27	0·0167	60	0·0144
12	0·0187	28	0·0166	70	0·0146
13	0·0186	29	0·0164	80	0·0149
14	0·0184	30	0·0163	90	0·0155
15	0·0183	31	0·0162	100	0·0166

(Bohr and Bock, W. Ann. **44.** 318.\

Absorption of hydrogen by H_2O at t° and 760 mm. pressure. β=coefficient of absorption. β_1=“solubility” (see under Oxygen).

t°	β	β_1
0	0·02148	0·02135
1	0·02126	0·02112
2	0·02105	0·02090
3	0·02084	0·02068
4	0·02064	0·02047
5	0·02044	0·02026
6	0·02025	0·02006
7	0·02007	0·01987
8	0·01989	0·01968
9	0·01972	0·01950
10	0·01955	0·01932
11	0·01940	0·01915
12	0·01925	0·01899
13	0·01911	0·01883
14	0·01897	0·01867
15	0·01883	0·01851
16	0·01869	0·01836
17	0·01856	0·01821
18	0·01844	0·01806
19	0·01831	0·01792
20	0·01819	0·01777
21	0·01805	0·01761
22	0·01792	0·01746
23	0·01779	0·01730
24	0·01766	0·01715
25	0·01754	0·01700
26	0·01742	0·01685
27	0·01731	0·01670
28	0·01720	0·01656
29	0·01709	0·01642
30	0·01699	0·01630
31	0·01692	0·01618
32	0·01685	0·01606
33	0·01679	0·01596
34	0·01672	0·01585
35	0·01666	0·01574
36	0·01661	0·01564
37	0·01657	0·01554
38	0·01652	0·01544
39	0·01648	0·01535
40	0·01644	0·01525
41	0·01640	0·01515
42	0·01635	0·01504
43	0·01631	0·01493
44	0·01627	0·01482
45	0·01624	0·01475
46	0·01620	0·01460
47	0·01617	0·01449
48	0·01614	0·01437
49	0·01611	0·01425
50	0·01608	0·01413
52	0·01606	0·01392
54	0·01605	0·01369
56	0·01603	0·01343
58	0·01602	0·01316
60	0·01600	0·01287
62	0·01600	0·01256
64	0·01600	0·01223
66	0·01600	0·01188
68	0·01600	0·01150
70	0·01600	0·01109

Absorption of hydrogen by H_2O, etc.—*Continued.*

t°	β	β_1
72	0·01600	0·01065
74	0·01600	0·01017
76	0·01600	0·00966
78	0·01600	0·00912
80	0·01600	0·00853
82	0·01600	0·00790
84	0·01600	0·00723
86	0·01600	0·00652
88	0·01600	0·00575
90	0·01600	0·00494
92	0·01600	0·00407
94	0·01600	0·00315
96	0·01600	0·00216
98	0·01600	0·00111
100	0·01600	0·0000

(Winkler, B. **24.** 99.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. H gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0·06925	9	0·06799	18	0·06690
1	0·06910	10	0·06786	19	0·06679
2	0·06896	11	0·06774	20	0·06668
3	0·06881	12	0·06761	21	0·06657
4	0·06867	13	0·06749	22	0·06646
5	0·06853	14	0·06737	23	0·06636
6	0·06839	15	0·06725	24	0·06621
7	0·06826	16	0·06713	...	...
8	0·06813	17	0·06701	...	...

(Bunsen's Gasometry, p. 286.)

One vol. alcohol absorbs $0·06925 - 0·0001487t + 0·000001t^2$ vols. H at t°. (Bunsen.)

Absorption of hydrogen by alcohol.

t°	Coeff. of absorption	t°	Coeff. of absorption
0	0·0676	13·4	0·0705
6·2	0·0693	18·8	0·0740

(Timofejeff.)

Coefficient of absorption in petroleum= 0·0582 at 20°, and 0·0652 at 10°. (Griewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Hydrogen arsenide.

See **Arsenic hydride.**

Hydrogen ***peroxide,*** H_2O_2.

Miscible with H_2O. Not stable in conc. solution. Aqueous solution gives up its H_2O_2 to ether. Ethereal solution is more stable than an aqueous solution of the same strength, and may be distilled without decomp. Miscible with alcohol.

Hydrogen phosphide, gaseous (Phosphine), PH_3.

Very slightly absorbed by H_2O.

Statements as to solubility in H_2O vary considerably.

(a) *Difficultly inflammable gas—*

1 vol. H_2O absorbs 0·1122 vol. PH_3. (Dybkowsky, J. B. **1866.** 735.)

1 vol. H_2O absorbs 0·125 vol. PH_3. (H. Davy.)

(b) *Easily inflammable gas—*

1 vol. H_2O absorbs 0·018 vol. PH_3. (Gengembre, Crell. Ann. **1.** 450.)

1 vol. H_2O absorbs 0·0214 vol. PH_3. (Henry.)

1 vol. H_2O absorbs 0·025 vol. PH_3. (Davy.)

1 vol. H_2O absorbs 0·125 vol. PH_3. (Dalton, Ann. Phil. **11.** 7.)

1 vol. H_2O absorbs 0·255 vol. PH_3. (Raymond, Scher. J. **5.** 389.)

Sol. in conc. H_2SO_4 without immediate decomp. (Buff, Pogg. **16.** 363.)

Absorbed by $CuSO_4$ + Aq and by Br. (Berthelot.)

Absorbed rapidly by Cu_2Cl_2 + Aq with formation of Cu_2Cl_2, $2PH_3$, and Cu_2Cl_2, $4PH_3$. (Riban, C. R. **88.** 581.)

1 vol. alcohol of 0·85 sp. gr. absorbs 0·5 vol.; 1 vol. ether absorbs 2 vols. (Graham.)

Sol. in volatile oils; 1 vol. oil of turpentine absorbs 3·25 vols. (Graham.)

Several varieties of blood absorb PH_3.

Hydrogen phosphide, liquid, P_2H_4.

Insol. in H_2O. Apparently sol. in alcohol and oil of turpentine, but solution is very quickly decomp. (Thénard, A. ch. (3) **14.** 5.)

—— ——, **solid,** P_4H_2.

Insol. in H_2O and alcohol. (Leverrier, A. ch. **60.** 174.)

Insol. in all liquids except liquid PH_2. (Thénard, A. ch. (3) **14.** 5.)

Instantly decomp. by HNO_3, or H_2SO_4 + Aq. Sol. with decomp. in alcoholic solution of KOH. (Thénard.)

Hydrogen selenide, H_2Se.

More sol. in H_2O than hydrogen sulphide. (Berzelius.)

Hydrogen silicide.

See **Silicon hydride.**

Hydrogen sulphide, H_2S.

(a) *Liquid.* Dissolves S on warming, which separates on cooling.

(b) *Gas.*

1 vol. H_2O absorbs 1·08 vols. H_2S at 10°. (Henry, **1803.**)

1 vol. H_2O absorbs 2·53 vols. H_2S at 15°. (de Saussure, Ann. Phil. **6.** 340.)

1 vol. H_2O absorbs 3 vols. H_2S at 11°. (Gay-Lussac and Thénard.)

1 vol. H_2O absorbs 3·66 vols. H_2S at ord. temp. (Thompson.)

1 vol. H_2O absorbs 2·5 vols. H_2S at ord. temp. (Dalton.)

1 vol. H_2O absorbs $4·3706 - 0·083687t + 0·0005213t^2$ vols. H_2S at temperatures between 2 and 43·3°. (Bunsen and Schönfeld, A. **93.** 26.)

At 0° and about 820 mm. pressure 1 ccm. H_2O absorbs 100 ccm. H_2S, while only about 4 ccm. are absorbed at ord. pressure. (de Forcrand and Villard, C. R. **106.** 1402.)

1 vol. H_2O at 760 mm. pressure and t° absorbs V vols. H_2S, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4·3706	14	3·3012	28	2·4357
1	4·2874	15	3·2326	29	2·3819
2	4·2053	16	3·1651	30	2·3290
3	4·1243	17	3·0986	31	2·2771
4	4·0442	18	3·0331	32	2·2262
5	3·9652	19	2·9687	33	2·1764
6	3·8872	20	2·9053	34	2·1277
7	3·8103	21	2·8430	35	2·0799
8	3·7345	22	2·7817	36	2·0332
9	3·6596	23	2·7215	37	1·9876
10	3·5858	24	2·6623	38	1·9430
11	3·5132	25	2·6091	39	1·8994
12	3·4415	26	2·5470	40	1·8569
13	3·3708	27	2·4909	...	...

(Schönfeld, A. **93.** 26.)

Less sol. in NaCl, or $CaCl_2$ + Aq than in H_2O.

At 18° and ord. pressure, 100 vols. alcohol of 0·84 sp. gr. absorb 606 vols. H_2S. (de Saussure, **1814.**)

1 vol. alcohol absorbs $17·891 - 0·65598t + 0·00661t^2$ vols. H_2S between 0 and 22°. (Carius.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. H_2S reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	17·891	9	12·523	18	8·225
1	17·242	10	11·992	19	7·814
2	16·606	11	11·475	20	7·415
3	15·983	12	10·971	21	7·030
4	15·373	13	10·480	22	6·659
5	14·776	14	10·003	23	6·300
6	14·193	15	9·539	24	5·955
7	13·623	16	9·088	...	...
8	13·066	17	8·650	...	...

(Carius, A. **94.** 140.)

Sol. in methyl acetate (Marchand), ether (Higgins).

Insol. in caoutchin.

Difficultly sol. in conc. H_2SO_4 with decomp.

Instantly decomp. by fuming HNO_3.

Sol. in glycerine in less amount than in H_2O. If a certain vol. of H_2O dissolves 100 pts. H_2S, the same vol. of glycerine (1 pt. glycerine +1 pt. H_2O) dissolves only 60 pts. H_2S, but the solution is very stable. After standing a year there is no appreciable decomp. (Lapage, J. Pharm. (4) **5.** 256.)

According to Lindo (C. N. **57.** 173), the solution in glycerine is no more stable than that in H_2O.

Sol. in CS_2.

$+7H_2O$. Easily decomp. by heat. (de Forcrand and Villard, C. R. **106.** 1402.)

Hydrogen *per*sulphide, H_2S_2 or H_2S_5.

Decomp. by contact with H_2O, in which it is apparently insol. Sol. in ether with subsequent decomp. Sol. in CS_2. (Thénard, A. ch. **48.** 79.)

H_2S_2. Quickly decomp. by ether, acetic ether, ethyl, or amyl alcohol. H_2S has no action.

Conc. HCl, or $HC_2H_3O_2$ + Aq have no action. Sol. in a solution of S in CS_2, and in liquid hydrocarbons.

Chloroform dissolves without decomp. (Sabatier, C. R. **100.** 1346, 1585.)

Alkalies, and K_2S + Aq decomp. instantly.

Formula is H_2S_5. (Rebs, A. **246.** 356.)

Hydrogen telluride, H_2Te.

Rather sol. in H_2O.

Hydrosulphuric acid, H_2S.

See **Hydrogen sulphide.**

Hydrosulphurous acid, H_2SO_2.

See **Hyposulphurous acid.**

Hydroxylamine, $NH_3O = NH_2(OH)$.

Known only in solution.

Sol. in alcohol. (Lossen, J. pr. **96.** 462.)

Prepared in free state by de Bruyn.

Very deliquescent, and sol. in H_2O and alcohol. Sl. sol. or insol. in $CHCl_3$, C_6H_6, ether, or ethyl acetate.

Methyl alcohol at 5° dissolves 35 %; ethyl alcohol at 15°, 15 %; boiling dry ether, 1·2 %; ethyl acetate, 1·6 %. (de Bruyn, R. t. c. **11.** 18.)

Hydroxylamine chloride, $NH_3(OH)Cl$.

Not deliquescent. Very sol. in H_2O and hot ordinary alcohol. Sl. sol. in absolute alcohol. Insol. in ether. (Lossen.)

100 pts. absolute methyl alcohol dissolve 16·4 pts. at 19·75°; 100 pts. absolute ethyl alcohol dissolve 4·43 pts. at 19·75°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Hydroxylamine chloride, basic, $NH_3(OH)Cl$, NH_2OH.

Sol. in H_2O. Alcohol precipitates from aqueous solution. Insol. in ether. (Lossen.)

$2NH_3(OH)Cl$, NH_2OH. Deliquescent; very sol. in H_2O, less in alcohol, and insol. in ether. (Lossen.)

Hydroxylamine zinc chloride, etc.

See **Zinc chloride hydroxylamine, etc.**

Hydroxylamine nitrate, $NH_3(OH)NO_3$.

Very sol. in H_2O and absolute alcohol. (Lossen.)

Hydroxylamine *ortho*phosphate, $(NH_3OH)_3PO_4$.

Sl. sol. in cold H_2O. (Lossen.)

Hydroxylamine sulphate, $(NH_3OH)_2SO_4$.

Easily sol. in H_2O. Precipitated from concentrated aqueous solution by alcohol. (Lossen.)

For double salts, see under sulphuric acid.

Hydroxylamine *mono*sulphonic acid, $HONH(SO_3H)$.

"Sulphazidic acid" of Fremy.

"Sulphydroxylamic acid" of Claus.

Sol. in H_2O. Slowly decomp. on boiling. (Raschig, A. **241.** 161.)

***Mono*barium hydroxylamine *mono*sulphate,** $(HONHSO_3)B_2a + H_2O$.

Easily sol. in H_2O. (Divers and Haga, Chem. Soc. **55.** 760.)

***Di*barium —— ——,** $Ba(HONSO_3)_2Ba + H_2O$.

Nearly insol. in H_2O; sol. in HCl + Aq. (Divers and Haga, Chem. Soc. **55.** 760.)

Potassium —— ——, $HONH(SO_3K)$.

"Potassium sulphydroxylamate" of Claus.

"Potassium sulphazidate" of Fremy.

Sol. in cold H_2O. Easily sol. in hot H_2O without decomp. Insol. in alcohol. (Raschig.)

$+H_2O$. (Divers and Haga, Chem. Soc. **55.** 760.)

Hydroxylamine *di*sulphonic acid, $HON(SO_3H)_2$.

"*Di*sulphydroazotic acid" of Claus.

"Sulphazotic acid" of Fremy.

Not known in free state. (Raschig, A. **241.** 161.)

Potassium hydroxylamine *di*sulphonate, $HON(SO_3K)_2 + 2H_2O$.

"Potassium *di*sulphydroxyazotate" of Claus (A. **158.** 75). Insol. in cold H_2O.

Very unstable. Very difficultly sol. in H_2O, more easily in dil. KOH + Aq. (Raschig, A. **241.** 161.)

***Di*hydroxylamine sulphonic acid,** $(HO)_2N(SO_3H)$.

"Sulphazinous acid" of Fremy.

Known only in its salts. (Raschig, A. **241.** 161.)

Potassium *di*hydroxylamine sulphonate, $(HO)_2NSO_3K$.

Not obtained in pure state; forms basic salt $\substack{KO\\HO}NSO_3K$, which is quite sol. in H_2O, and corresponds to "sulfazite de potasse" of Fremy (A. ch. (3) **15.** 421).

Sol. in H_2O; insol. in alcohol and ether. (Fremy.)

Hydroxyloiodoplatin*di*amine sulphate, $(OH)IPt(NH_3)_4SO_4 + H_2O$.

Very sl. sol., even in boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 312.)

Hydroxylonitratoplatin*di*amine nitrate,

$$\substack{OH\\NO_3}Pt\substack{N_2H_6NO_3\\N_2H_6NO_3}.$$

Sl. sol. in cold, more easily in hot H_2O. Very sl. sol. in H_2O containing HNO_3. (Cleve.)

—— ***pyro*phosphate,**

$$\left[\substack{OH\\NO_3}Pt\substack{N_2H_6\\N_2H_6}\right]_2 P_2O_7 + H_2O.$$

Very sl. sol. in H_2O. (Cleve.)

Hydroxyloplatinamine hydroxide, $(OH)_2Pt(NH_3OH)_2$.

Insol. in H_2O. Easily sol. in dil. acids, even

$HC_2H_3O_2$ + Aq. Not decomp. by boiling KOH + Aq. (Gerhardt, Compt. Chem. **1849.** 490.)

Hydroxyloplatinamine nitrate, $(OH)_2Pt(NH_3NO_3)_2 + 2H_2O$.
Sl. sol. in cold, easily in hot H_2O; not attacked by cold HCl + Aq. (Cleve.)

—— **oxalate,** $(OH)_2Pt(NH_3)_2C_2O_4 + H_2O$.
Sol. in hot H_2O.

—— **sulphate,** $(OH)_2Pt(NH_3)_2SO_4 + H_2O$.
Difficultly sol. in H_2O. (Cleve.)

Hydroxyloplatin*di*amine bromide, $(OH)_2Pt(NH_3)_4Br_2$.
Sl. sol., even in boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 320.)

—— **chloride,** $(OH)_2Pt(NH_3)_4Cl_2$.
Sol. in 206 pts. cold, and 49 pts. boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 316.)

—— **chromate,** $(OH)_2Pt(NH_3)_4Cr_2O_7$.
Very sl. sol. in cold or hot H_2O. (Carlgren, Sv. V. A. F. **47.** 319.)

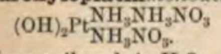
—— **iodide,** $(OH)_2Pt(NH_3)_4I_2$.
Sl. sol. in hot or cold H_2O. (Carlgren.)

—— **nitrate,** $(OH)_2Pt(NH_3)_4(NO_3)_2$.
Sl. sol. in cold, moderately sol. in hot H_2O. (Gerhardt, A. **76.** 315.)
Sol. in 343 pts. cold, and 38 pts. boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 318.)

—— **nitrite,** $(OH)_2Pt(NH_3)_4(NO_2)_2$.
Easily sol. in H_2O. (Carlgren.)

—— **sulphate,** $(OH)_2Pt(NH_3)_4SO_4$.
Very sl. sol. in boiling H_2O. (Cleve.)
+ $4H_2O$. Efflorescent. (Carlgren, Sv. V. A. F. **47.** 313.)

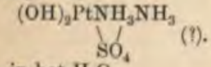
Hydroxyloplatin*monodi*amine nitrate,


$(OH)_2Pt\genfrac{}{}{0pt}{}{NH_3NH_3NO_3}{NH_3NO_3}$.

Very easily sol. in H_2O. (Cleve.)

Hydroxyloplatin*semidi*amine nitrate, $(OH)_3PtNH_3NH_3NO_3$ (?).
Easily sol. in H_2O. (Cleve.)

—— **sulphate,**


$\begin{array}{c}(OH)_2PtNH_3NH_3\\ \backslash\ /\\ SO_4\end{array}$ (?).

Sol. in hot H_2O.

Hydroxylo*di*platin*di*amine chloride, $(OH)_2Pt_2(N_2H_6)_4Cl_4 + H_2O$.
Extremely sl. sol. in H_2O.

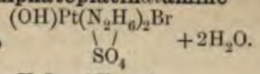
—— ***di*chromate,** $(OH)_2Pt_2(N_2H_6)_4(Cr_2O_7)_2$.
Ppt. (Cleve.)

—— **nitrate,** $(OH)_2Pt_2(N_2H_6)_4(NO_3)_4$.
Very sl. sol. in cold, more easily in hot H_2O. (Cleve.)

—— **phosphate,** $(OH)_2Pt_2(N_2H_6)_4(PO_4H)_2$.
Ppt.

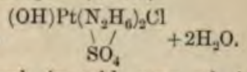
—— **sulphate,** $(OH)_2Pt_2(N_2H_6)_4(SO_4)_2 + 2H_2O$.
Ppt. Nearly insol. in H_2O.

Hydroxylosulphatoplatin*di*amine bromide,


$\begin{array}{c}(OH)Pt(N_2H_6)_2Br\\ \backslash\ /\\ SO_4\end{array} + 2H_2O$.

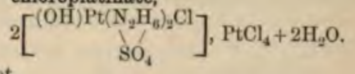
Easily sol. in H_2O. (Cleve.)

—— **chloride,**


$\begin{array}{c}(OH)Pt(N_2H_6)_2Cl\\ \backslash\ /\\ SO_4\end{array} + 2H_2O$.

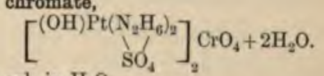
Moderately sol. in cold, very sol. in hot H_2O.

—— **chloroplatinate,**


$2\left[\begin{array}{c}(OH)Pt(N_2H_6)_2Cl\\ \backslash\ /\\ SO_4\end{array}\right], PtCl_4 + 2H_2O$.

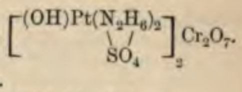
Ppt.

—— **chromate,**


$\left[\begin{array}{c}(OH)Pt(N_2H_6)_2\\ \backslash\ /\\ SO_4\end{array}\right]_2 CrO_4 + 2H_2O$.

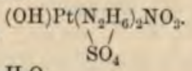
Sl. sol. in H_2O.

—— ***di*chromate,**


$\left[\begin{array}{c}(OH)Pt(N_2H_6)_2\\ \backslash\ /\\ SO_4\end{array}\right]_2 Cr_2O_7$.

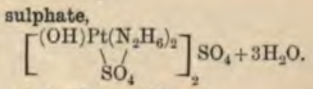
Sl. sol. in H_2O.

—— **nitrate,**


$\begin{array}{c}(OH)Pt(N_2H_6)_2NO_3\\ \backslash\ /\\ SO_4\end{array}$.

Sol. in hot H_2O.

—— **sulphate,**


$\left[\begin{array}{c}(OH)Pt(N_2H_6)_2\\ \backslash\ /\\ SO_4\end{array}\right]_2 SO_4 + 3H_2O$.

Sl. sol. in H_2O. (Cleve.)

Hypoantimonic acid.

Calcium hypoantimonate (?), $Ca_2Sb_3O_8$.
Min. *Roméite.* Insol. in acids.

Potassium hypoantimonate, $K_2Sb_2O_5$.
Sol. in hot H_2O. Sol. in 425 pts. boiling H_2O (Brandes). Sol. in boiling KOH + Aq (Berzelius).
$K_2Sb_4O_9$. Ppt.

Hypobromous acid, HBrO.

Known only in aqueous solution.
Solution containing 6·21 pts. Br as HBrO in 100 ccm. H_2O decomposes at 30°. If dilute solution is distilled in vacuo, an acid containing 0·736 pt. Br as HBrO in 100 ccm. is obtained at first, but the distillate slowly grows weaker. Dil. solution, stable at ordinary temp., decomp. by heating over 60°. (Dancer, A. **125.** 237.)

Barium hypobromite.
Known only in solution.

Calcium hypobromite *with* $CaBr_2$.
Deliquescent, and sol. in H_2O with partial decomp. (Berzelius.)

Potassium hypobromite, KBrO.
Known only in solution.

Sodium hypobromite.
Known only in solution.

Strontium hypobromite.
Known only in solution.

Hypochlorous acid, $HClO$.

Miscible with H_2O. Decomposes at 0° in the dark, more rapidly at higher temp. or in light. The stronger the solution the more rapid the decomposition. Moderately strong acid may be distilled without any considerable decomp., a stronger acid distilling over at first, and afterwards an acid weaker than the original acid. Very conc. or very dil. acids decomp. by distillation.

Ammonium hypochlorite.

Known only in aqueous solution, which decomposes at once.

Barium hypochlorite.

Known only in solution.

Calcium hypochlorite, $Ca(OCl)_2+4H_2O$.

Deliquescent, and sol. in H_2O. (Kinzgett, Chem. Soc. (2) **13.** 404.)

Calcium hypochlorite chloride, etc. (bleaching powder), $Ca(OCl)_2$, $CaCl_2$, $Ca(OH)_2+H_2O$.

Not deliquescent. Sol. in H_2O. Alcohol does not dissolve out $CaCl_2$. Sol. in 20 pts. H_2O with a slight residue.

Correct formula is $CaOCl_2$ (Lunge and Schäppi; Kraut, A. **214.** 354), $\mathrm{Ca}^{\mathrm{OCl}}_{\mathrm{OH}}$ (Stahlschmidt, B. **8.** 869), $CaOCl$, Cl (Odling).

$CaCl_2$ *is* dissolved out by alcohol. Formula $= 2\mathrm{Ca}^{\mathrm{OH}}_{\mathrm{OCl}}\mathrm{CaCl}+2H_2O$. (Dreyfuss, Bull. Soc. (2) **41.** 600.)

Didymium hypochlorite, $Di(OCl)_3$.

Difficultly sol. in H_2O. Easily sol. in acids. (Frerichs and Smith, A. **191.** 348.)

Lanthanum hypochlorite, $La(OCl)_3$.

Easily sol. in H_2O. (Frerichs and Smith.)

Magnesium hypochlorite.

Known only in solution.

Potassium hypochlorite, $KClO$.

Known only in solution.

Silver hypochlorite, $AgClO$.

Very sol. in H_2O, and decomp. very quickly. (Stas, Acad. R. de Belg. **35.** 103.)

Sodium hypochlorite, $NaClO$.

Known only in solution.

Hypoiodic acid, I_2O_4.

See **Iodine *tet*roxide.**

Hypoiodous acid.

Calcium hypoiodite iodide, $Ca(OI)_2$, CaI_2.

Not very unstable. (Lunge and Shoch, B. **15.** 1883.)

Hyponitric acid, N_2O_4.

See **Nitrogen *tet*roxide.**

Hyponitrous acid, HNO, or better $H_2N_2O_2$.

Known only in aqueous solution. Solution is quite stable. (van der Plaats, B. **10.** 1507.)

Barium hyponitrite, BaN_2O_2.

Nearly insol. in, but gradually decomp. by H_2O. Sol. in conc. acids with evolution of N_2O, but sol. in dil. $HC_2H_3O_2+Aq$ without decomp. (Zorn, B. **15.** 1007.)

$+xH_2O$. Efflorescent. (Maquenne, C. R. **108.** 1303.

Barium hyponitrite acetate, BaN_2O_2, $Ba(C_2H_3O_2)_2$, $2HC_2H_3O_2+3H_2O$.

Sol. in H_2O. (Maquenne, C. R. **108.** 1303.)

Calcium hyponitrite, $CaN_2O_2+4H_2O$.

Nearly insol. in H_2O; easily sol. in dil. acids. (Maquenne, C. R. **108.** 1303.)

Calcium hyponitrite acetate, CaN_2O_2, $Ca(C_2H_3O_2)_2$, $2HC_2H_3O_2+4H_2O$.

Sol. in H_2O. (Maquenne.)

Potassium hyponitrite, $K_2N_2O_2$.

Sol. in H_2O. (van der Plaats.)

Silver hyponitrite (nitrosyl silver), $Ag_2N_2O_2$.

Insol. in H_2O. Easily sol. in dil. HNO_3+Aq or H_2SO_4+Aq.

Decomp. by H_3PO_4, H_2S, and boiling $HC_2H_3O_2+Aq$. (van der Plaats.)

Insol. in $HC_2H_3O_2+Aq$; sol. in NH_4OH+Aq. (Divers, C. N. **23.** 206.)

Sodium hyponitrite, $Na_2N_2O_2+6H_2O$.

Sol. in H_2O. (van der Plaats.)

Strontium hyponitrite, $SrN_2O_2+5H_2O$.

Nearly insol. in H_2O; easily sol. in dil. acids. (Maquenne, C. R. **108.** 1303.)

Strontium hyponitrite acetate, SrN_2O_2, $Sr(C_2H_3O_2)_2$, $2HC_2H_3O_2+3H_2O$.

Sol. in H_2O. (Maquenne.)

Hypophosphomolybdic acid.

Ammonium hypophosphomolybdate, $2(NH_4)_2O$, $2H_3PO_2$, $8MoO_3+2H_2O$.

Not very sol. in cold H_2O, readily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 402.)

Hypophosphoric acid, $H_4P_2O_6$.

Very deliquescent, and sol. in the least amount of H_2O. (Joly, C. R. **101.** 1058.)

$+H_2O$. (Sänger, A. **232.** 14.)

Does not exist. (Joly.)

$+2H_2O$. Very deliquescent. (Joly.)

Aluminum hypophosphate, $Al_4(P_2O_6)_3+23H_2O$.

Easily sol. in mineral acids. Sol. in $Na_4P_2O_6+Aq$. (Palm, Dissertation, Rostock, **1890.**)

Ammonium hypophosphate, $(NH_4)_2PO_3+\frac{1}{2}H_2O$, or $(NH_4)_4P_2O_6+H_2O$.

Sol. in 30 pts. H_2O. (Salzer, A. **194.** 32.)

Ammonium hydrogen hypophosphate, NH_4HPO_3, or $(NH_4)_2H_2P_2O_6$.

Sol. in 14 pts. cold, and 4 pts. boiling H_2O. (Salzer, A. **194.** 32.)

Ammonium *tri*hydrogen hypophosphate, $NH_4H_3P_2O_6$.

Sol. in H_2O. (Salzer, A. **211.** 1.)

Ammonium magnesium hypophosphate, $(NH_4)_2MgP_2O_6+6H_2O$.

Precipitate. (Salzer, A. **232.** 114.)

Barium hypophosphate, $Ba_2P_2O_6$.

Very slightly sol., but not wholly insol. in H_2O. Very slightly sol. in acetic acid, but more soluble in hydrochloric, and hypophosphoric acids. (Salzer, A. **194.** 34.)

Barium hydrogen hypophosphate, $BaH_2P_2O_6+2H_2O$.

Soluble in about 1000 pts. H_2O. Solution decomposes by heating. (Salzer, A. **194.** 34.)

Bismuth hypophosphate, $Bi_4(P_2O_6)_3+8\frac{1}{2}H_2O$.

Completely sol. in HCl+Aq, also in warm HNO_3+Aq. Insol. in boiling dil. H_2SO_4+Aq. Sl. sol. by long boiling with conc. H_2SO_4. (Palm, Rostock, **1890.**)

Cadmium hypophosphate, $Cd_2P_2O_6+2H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Cadmium sodium hypophosphate, $CdNa_2P_2O_6+6H_2O$.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids. (Drawe.)

Calcium hypophosphate, $Ca_2P_2O_6+2H_2O$.

Insol. in H_2O; difficultly sol. in $HC_2H_3O_2$, easily sol. in $H_4P_2O_6$, or HCl+Aq. (Salzer, A. **194.** 36.)

Calcium hydrogen hypophosphate, $CaH_2P_2O_6+6H_2O$.

Sol. in 60 pts. H_2O. (Salzer, A. **232.** 114.)

Chromic hypophosphate, $Cr_4(P_2O_6)_3+34H_2O$.

Sol. in HCl+Aq on sl. warming, also in HNO_3+Aq. Not completely sol. in dil. H_2SO_4+Aq, but completely sol. in conc. H_2SO_4. (Palm, Dissertation, Rostock, **1890.**)

Cobaltous hypophosphate, $Co_2P_2O_6+8H_2O$.

Insol. in H_2O. Easily sol. in acids. (Drawe, B. **21.** 3403.)

Cobaltous sodium hypophosphate, $CoNa_2P_2O_6+1\frac{1}{2}H_2O$.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Cupric hypophosphate, $Cu_2P_2O_6+6H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Glucinum hypophosphate, $Gl_2P_2O_6+7H_2O$.

Insol. in H_2O. Moderately sol. in all mineral acids. (Palm, Rostock, **1890.**)

$+3H_2O$. (Rammelsberg.)

Ferrous hypophosphate, $Fe_2P_2O_6+4\frac{1}{2}H_2O$.

Insol. in H_2O. Sol. in cold HCl+Aq. Decomp. by hot HNO_3+Aq into $Fe_4(P_2O_6)_3$. Insol. in HNO_3+Aq. Insol. in boiling dil. H_2SO_4+Aq. Somewhat sol. in cold H_2SO_4, but a ppt. separates out on heating. (Palm, Rostock, **1890.**)

Ferric hypophosphate, $Fe_4(P_2O_6)_3+20H_2O$.

Easily sol. in HCl+Aq. Wholly insol. in HNO_3, and dil. H_2SO_4+Aq. Completely sol. in conc. H_2SO_4 by warming a short time, but a ppt. separates out on boiling. (Palm.)

Lead hypophosphate, $Pb_2P_2O_6$.

Insol. in H_2O, $HC_2H_3O_2$, or $H_4P_2O_6$+Aq; sol. in dil. HNO_3+Aq. (Salzer.)

Lithium hypophosphate, $Li_4P_2O_6+7H_2O$.

Very sl. sol. in H_2O. (Salzer, A. **194.** 28.)

Sol. in 120 pts. H_2O at ord. temp. (Rammelsberg, J. pr. (2) **45.** 153.)

$Li_2H_2P_2O_6+2H_2O$. Deliquescent. (Rammelsberg.)

Magnesium hypophosphate, $Mg_2P_2O_6+12H_2O$.

Sol. in 15,000 pts. H_2O; sl. sol. in acetic, easily in hypophosphoric, or mineral acids. (Salzer, A. **232.** 114.)

$+24H_2O$. (Rammelsberg.)

Magnesium hydrogen hypophosphate, $MgH_2P_2O_6+4H_2O$.

Sol. in 200 pts. H_2O. (Salzer, A. **232.** 114.)

Manganese hypophosphate, $Mn_2P_2O_6+2\frac{1}{2}H_2O$.

Insol. in H_2O; sol. in mineral acids, insol. in acetic acid. (Palm, Dissertation, Rostock, **1890.**)

Manganous sodium hypophosphate, $Mn_2P_2O_6$, $Na_4P_2O_6+11H_2O$.

Insol. in H_2O; sol. in mineral acids. (Palm.)

Nickel hypophosphate, $Ni_2P_2O_6+12H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3401.)

Nickel sodium hypophosphate, $NiNa_2P_2O_6+12H_2O$.

Insol. in H_2O, but decomp. thereby. Easily sol. in dil. acids. (Drawe.)

Potassium hypophosphate, $K_4P_2O_6+8H_2O$.

Sol. in ¼ pt. H_2O; insol. in alcohol. (Salzer, A. **211.** 1.)

Potassium hydrogen hypophosphate, $K_3HP_2O_6+3H_2O$.

Sol. in ½ pt. H_2O. (Salzer, A. **211.** 1.)

Potassium *di*hydrogen hypophosphate, $K_2H_2P_2O_6+3H_2O$, and $+2H_2O$.

Sol. in 3 pts. cold, and 1 pt. boiling H_2O. (Salzer, A. **211.** 1.)

Potassium *tri*hydrogen hypophosphate, $KH_3P_2O_6$.

Sol. in 1½ pts. cold, and ½ pt. hot H_2O. (Salzer, A. **211.** 1.)

Potassium *penta*hydrogen *di*hypophosphate, $K_3H_5(P_2O_6)_2+2H_2O$.

Sol. in 2½ pts. cold, and ⅘ pt. boiling H_2O. (Salzer, A. **211.** 1.)

Silver hypophosphate, $Ag_4P_2O_6$.

Sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. Very sl. sol. in $H_4P_2O_6$+Aq. (Salzer, A. **232.** 114.)

Sodium hypophosphate, $Na_4P_2O_6+10H_2O$.

Sol. in about 30 pts. cold, much more easily in hot H_2O. (Salzer.)

Sodium hydrogen hypophosphate, $Na_3HP_2O_6+9H_2O$.

Sol. in 22 pts. H_2O. (Salzer.)

Sodium *di*hydrogen hypophosphate, $Na_2H_2P_2O_6+6H_2O$.

Sol. in 45 pts. cold, and 5 pts. boiling H_2O. More sol. in dil. H_2SO_4+Aq. Insol. in alcohol. (Salzer, A. **187.** 331.)

Sodium *tri*hydrogen hypophosphate, $NaH_3P_2O_6$.

Sol. in H_2O. (Salzer, A. **211.** 1.)

Sodium *tri*hydrogen *di*hypophosphate, $Na_5H_3(P_2O_6)_2+20H_2O$.

Very efflorescent. Sol. in 15 pts. cold H_2O. (Salzer, A. **211.** 1.)

Zinc hypophosphate, $Zn_2P_2O_6+2H_2O$.

Insol. in H_2O. Easily sol. in dil. acids. (Drawe, B. **21.** 3403.)

Hypophosphorous acid, H_3PO_2.

Very sol. in H_2O and alcohol. (Rose.)

Aluminum hypophosphite.

Not deliquescent, but very sol. in H_2O. (Rose, Pogg. **12.** 86.)

Ammonium hypophosphite, $NH_4H_2PO_2$.

Sol. in H_2O, less deliquescent than the potassium salt. (Wurtz, A. ch. (3) **7.** 193.)

Very sol. in absolute alcohol. (Dulong.)

Barium hypophosphite, $Ba(H_2PO_2)_2+H_2O$.

Sol. in 3·5 pts. cold, and 3 pts. boiling H_2O. Insol. in alcohol. (Wurtz, A. **43.** 323.)

Cadmium hypophosphite.

Sol. in H_2O. (Rose, Pogg. **12.** 91.)

Calcium hypophosphite, $Ca(PH_2O_2)_2$.

Sol. in 6 pts. cold, and not much more sol. in hot H_2O. Insol. in strong, very sl. sol. in weak alcohol. (Rose, Pogg. **9.** 361.)

Calcium cobaltous hypophosphite, $2Ca(PH_2O_2)_2, Co(PH_2O_2)_2+2H_2O$.

Efflorescent. (Rose, Pogg. **12.** 295.)

Calcium ferrous hypophosphite.

Sol. in H_2O. (Rose, Pogg. **12.** 294.)

Cerous hypophosphite, $Ce(PH_2O_2)_3+H_2O$.

Sl. sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 437.)

Chromium hypophosphite, $Cr_2(OH)_2(H_2PO_2)_4$.

Anhydrous. Insol. in H_2O or dil. acids.

$+3H_2O$. Sol. in H_2O. (Wurtz, A. ch. (3) **16.** 196.)

Cobaltous hypophosphite, $Co(PH_2O_2)_2+6H_2O$.

Efflorescent. Easily sol. in H_2O. (Rose, Pogg. **12.** 87.)

Cupric hypophosphite, $Cu(PH_2O_2)_2$.

Very sol. in H_2O, but very easily decomp. on heating. (Wurtz, A. ch. (3) **16.** 199.)

Glucinum hypophosphite.

Sol. in H_2O. (Rose, Pogg. **12.** 86.)

Ferrous hypophosphite, $Fe(PH_2O_2)_2+6H_2O$.

Sol. in H_2O. (Rose, Pogg. **12.** 294.)

Ferric hypophosphite.

Difficultly sol. in H_2O or acids. Decomp. on boiling. Sl. sol. in H_3PO_2+Aq. (Rose.)

Lead hypophosphite, $Pb(PH_2O_2)_2$.

Difficultly sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Rose, Pogg. **12.** 288.)

Lithium hypophosphite, $LiH_2PO_2+H_2O$.

Sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 416.)

Magnesium hypophosphite, $Mg(PH_2O_2)_2+6H_2O$.

Efflorescent in dry air. Sol. in H_2O. (Rose.)

Manganous hypophosphite, $Mn(H_2PO_2)_2+H_2O$.

Permanent. Very sol. in H_2O. (Wurtz, A. ch. (3) **16.** 195.)

Nickel hypophosphite, $Ni(PH_2O_2)_2+6H_2O$.

Efflorescent. Sol. in H_2O. (Rammelsberg, B. **5.** 494.)

Platinous hypophosphite $Pt(PH_2O_2)_2$.

Insol. in H_2O, HCl, H_2SO_4+Aq, etc. Sol. in HNO_3+Aq. Insol. in alcohol. (Engel, C. R. **91.** 1068.)

Potassium hypophosphite, KH_2PO_2.

Very deliquescent. Very sol. in H_2O. Easily sol. in weak, less in absolute alcohol. Insol. in ether. (Wurtz, A. ch. (3) **7.** 192.)

Sodium hypophosphite, $NaH_2PO_2+H_2O$.

Very deliquescent. Somewhat less sol. than the K salt. Very sol. in absolute alcohol. (Dulong.)

Very sol. in H_2O, and somewhat less sol. in alcohol. (Rammelsberg, B. A. B. **1872.** 412.)

Strontium hypophosphite, $Sr(PH_2O_2)_2$.

Very easily sol. in H_2O. (Dulong.)

Insol. in alcohol. (Wurtz.)

Thallous hypophosphite, TlH_2PO_2.

Sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 492.)

Uranyl hypophosphite, $UO_2(H_2PO_2)_2+H_2O$.

Sl. sol. in H_2O. Easily sol. in HCl, or HNO_3+Aq. (Rammelsberg, Chem. Soc. (2) **11.** 1.)

Zinc hypophosphite, $Zn(H_2PO_2)_2+H_2O$.

Sol. in H_2O.

$+6H_2O$. Efflorescent. (Wurtz, A. ch. (3) **16.** 195.)

Hypophosphotungstic acid.

Potassium hypophosphotungstate, $4K_2O, 6H_3PO_2, 18WO_3+7H_2O$.

Precipitate. Sol. in hot, very sl. sol. in cold H_2O. (Gibbs, Am. Ch. J. **5.** 361.)

Hyposulpharsenious acid.

Hyposulpharsenites, As_2S_2, M_2S.

Difficultly sol. in H_2O. (Berzelius.)

Do not exist. (Nilson, B. **4.** 989.)

Hyposulphuric acid, $H_2S_2O_6$.

See **Dithionic acid.**

Hyposulphurous acid, $H_2S_2O_3$.

See **Thiosulphuric acid.**

Hyposulphurous (Hydrosulphurous) acid, H_2SO_2.

Known only in dil. aqueous solution, which decomposes rapidly.

Correct formula is $H_2S_2O_4$, according to Bernthsen (A. **211.** 285).

More sol. in alcohol than in H_2O. (Rössler, Arch. Pharm. (3) **25.** 845.)

Sodium hyposulphite, $NaHSO_2$.

Very sol. in H_2O or dil. alcohol, but not in strong alcohol.

According to Bernthsen (B. **13.** 2277), formula is $Na_2S_2O_4$.

Hypovanadic acid, $V_2O_2(OH)_4$.

See **Vanadium *tetr*hydroxide.**

Hypovanadic acid *with* vanadic acid.

See **Vanadicovanadic acid.**

Ammonium hypovanadate, basic, $2(NH_4)_2O, V_2O_4$.

Sl. sol. in cold, easily in hot H_2O. (Ditte, C. R. **102.** 1310.)

Ammonium hypovanadate, $(NH_4)_2V_4O_9+3H_2O$.

Sol. in H_2O. (Crow, Chem. Soc. **30.** 460.)

Barium hypovanadate, $BaV_4O_9+5H_2O$.

Precipitate. Easily sol. in HNO_3, or HCl + Aq. (Crow, Chem. Soc. **30.** 460.)

Lead hypovanadate, PbV_4O_9.

Ppt. (Crow.)

Potassium hypovanadate, $K_2V_4O_9+7H_2O$.

Easily sol. in H_2O. Insol. in cold, sol. in hot KOH + Aq. Insol. in alcohol. (Crow.)

$+H_2O$. (Ditte, C. R. **102.** 1310.)

Silver hypovanadate, $Ag_2V_4O_9$.

Ppt. (Crow.)

Sodium hypovanadate, $Na_2V_4O_9+7H_2O$.

Easily sol. in H_2O. (Crow, Chem. Soc. **30.** 459.)

*Di*imido*di*phosphor*mon*amic acid,

$$HO—PO<^{NH}_{NH}>PO—NH_2.$$

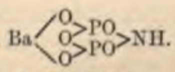
Correct formula for *pyro*phospho*tri*amic acid of Gladstone. (Mente, A. **248.** 241.)

Imido*di*phosphoric acid,

$$HO—PO<^{O}_{NH}>PO—OH.$$

Correct name for *pyro*phosphamic acid. (Mente, A. **248.** 241.)

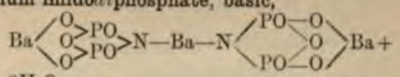
Barium imido*di*phosphate,



$$Ba\left\langle\begin{matrix}O\\O\\O\end{matrix}\right.\begin{matrix}>PO\\>PO\end{matrix}>NH.$$

Sl. sol. in H_2O. (Mente, A. **248.** 243.)

Barium imido*di*phosphate, basic,



$$Ba\left\langle\begin{matrix}O\\O\\O\end{matrix}\right.\begin{matrix}>PO\\>PO\end{matrix}>N—Ba—N\left\langle\begin{matrix}PO—O\\ \ \ \ \ \ \ O\\PO—O\end{matrix}\right\rangle Ba+$$

$2H_2O$.

Ppt. (Mente.)

Ferric imido*di*phosphate.

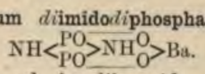
Sl. sol. in conc. acids. (Mente, A. **248.** 241.)

*Di*imido*di*phosphoric acid,

$$HO—PO<^{NH}_{NH}>PO—OH.$$

Correct name for *pyro*phospho*di*amic acid. (Mente, A. **248.** 241.)

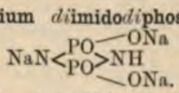
Barium *di*imido*di*phosphate,



$$NH<^{PO}_{PO}>NH^{O}_{O}>Ba.$$

Sl. sol. in dil. acids. (Mente, A. **248.** 244.)

Sodium *di*imido*di*phosphate, basic,



$$NaN<^{PO—ONa}_{PO—ONa}>NH.$$

Sl. sol. in H_2O. (Mente, A. **248.** 245.)

Imidosulphonic acid,

$$H_3S_2O_6N=HN<^{SO_2—OH}_{SO_2—OH.}$$

Ammondisulphonic acid of Claus. Known only in aqueous solution. (Divers and Haga, Chem. Soc. **61.** 943.)

Very unstable. (Berglund, B. **9.** 252.)

Ammonium imidosulphonate, basic, $(NH_4)N(SO_3NH_4)_2$.

Much less sol. than the neutral salt. (Berglund, B. **9.** 255.)

= "*Para*sulphatammon."

$+H_2O$. Gradually efflorescent. Sol. in H_2O with subsequent decomp. (Divers and Haga.)

Ammonium imidosulphonate, $HN(SO_3NH_4)_2$.

Sol. in H_2O. (Raschig, A. **241.** 161.)

Ammonium barium imidosulphonate, $NH_4BaN(SO_3)_2$ (?).

Very sl. sol. in H_2O. (Divers and Haga.)

$(NH_4)_2Ba_5N_4(SO_3)_8+8H_2O$. (D. and H.)

Ammonium sodium imidosulphonate, $NH_4Na_5N_2(SO_3)_4+7H_2O$, and $2\frac{1}{2}H_2O$.

Very sl. sol. in NH_4OH + Aq. (Divers and Haga.)

Ammonium sodium imidosulphonate nitrate, $HN(SO_3NH_4)_2$, $NaNO_3$.

Very sol. in H_2O. (Divers and Haga.)

Barium imidosulphonate, $Ba[N(SO_3)_2Ba]_2+5H_2O$.

Sl. sol. in H_2O. (Berglund, B. **9.** 255.)

Sol. in dil. HNO_3 + Aq without decomp. (Divers and Haga.)

$HN(SO_3)_2Ba+H_2O$. Moderately sol. in H_2O. (D. and H.)

Calcium imidosulphonate, $Ca[N(SO_3)_2Ca]_2+6H_2O$.

Sl. sol. in H_2O. (Berglund.)

Calcium sodium imidosulphonate, $NaN(SO_3)_2Ca+3H_2O$.

Sl. sol. in cold H_2O. (Divers and Haga, Chem. Soc. **61.** 968.)

Lead imidosulphonate, $(PbOHSO_3)_2NPbOH$.

Ppt. (Berglund.)

Insol. in H_2O. (Divers and Haga.)

$(PbOH)_3N(SO_3)_2$, PbO. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (D. and H.)

Potassium imidosulphonate, basic, $KN(SO_3K)_2+H_2O$.

Sol. in H_2O. (Raschig, A. **241.** 161.)

Less sol. than neutral salt. (Berglund.)

Potassium imidosulphonate, $HN(SO_3K)_2$.

Sol. in H_2O. (Raschig, A. **241.** 161.)

=Potassium ammon*di*sulphonate of Claus.

Difficultly sol. in cold H_2O, sol. in 64 pts. H_2O at 23°. (Fremy.) Gradually decomp. by boiling. (Claus.)

Sl. sol. in H_2O. (Berglund, B. **9.** 255.)

Potassium mercurimidosulphonate, $N_2Hg(SO_3K)_4+4H_2O$.

See **Mercurimidosulphonic acid.**

Silver imidosulphonate, $AgN(SO_3Ag)_2$.

Sl. sol. in H_2O. (Berglund.)

Silver sodium imidosulphonate, $NaN(SO_3Ag)_2$.

Sl. sol. in H_2O. (Divers and Haga.)

$AgNa_2N(SO_3)_2$. Sl. sol. in H_2O, but more sol. than the two preceding salts. (D. and H.)

Sodium imidosulphonate, $HN(SO_3Na)_2+2H_2O$.

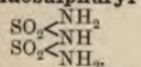
Not efflorescent. Very sol. in H_2O. (Divers and Haga.)

$NaN(SO_3Na)_2+12H_2O$. Efflorescent. Sl. sol. in cold H_2O, but very sol. in hot H_2O. Sol. in 5·4 pts. H_2O at 27·5°. (Divers and Haga.)

Strontium imidosulphonate, $Sr[N(SO_3)_2Sr]_2+6H_2O$.

Sl. sol. in H_2O. (Berglund.)

Imidosulphuryl amide, $S_2O_4N_3H_5=$



$$\begin{array}{l} SO_2<^{NH_2}_{NH} \\ SO_2<_{NH_2} \end{array}$$

Sol. in NH_4OH+Aq. Decomp. by conc. HCl. Insol. in alcohol sat. with NH_3. (Mente, A **248.** 265.)

Indium, In.

Does not decomp. hot H_2O.

Sol. in dil. HCl, and H_2SO_4+Aq. Decomp. by conc. H_2SO_4. Easily sol. in HNO_3+Aq. Insol. in acetic acid. Insol. in $KOH+Aq$. (Winkler, J. pr. **102.** 273.)

Indium bromide, $InBr_3$.

Deliquescent. Very sol. in H_2O.

Indium *mono*chloride, InCl.

Deliquescent. Decomp. by H_2O into $InCl_3$ and In. (Nilson and Pettersson, Chem. Soc. **43.** 820.)

Indium *di*chloride, $InCl_2$.

Deliquescent in moist air; decomp. by H_2O into $InCl_3$ and In. (Nilson and Pettersson, Chem. Soc. **43.** 818.)

Indium *tri*chloride, $InCl_3$.

Very deliquescent; sol. in H_2O with hissing and great evolution of heat.

Indium lithium chloride.

Extremely deliquescent. Sol. in H_2O. (Meyer, A. **150.** 144.)

Indium potassium chloride, 3KCl, $InCl_3+1\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Meyer.)

Indium hydrosulphide.

Decomp. by acids. (Meyer.)

Indium hydroxide, $In_2O_6H_6$.

Sol. in acids; also in KOH, or $NaOH+Aq$, but the solution clouds up on standing or boiling, with separation of $In_2O_6H_6$. Insol. in NH_4OH, or NH_4Cl+Aq.

Indium iodide, InI_3.

Deliquescent. (Meyer.)

Indium *mon*oxide, InO.

Gradually sol. in $HCl+Aq$. (Winkler, J. pr. **94.** 1.)

Indium *sesqui*oxide, In_2O_3.

Slowly sol. in cold, easily in hot acids.

Indium oxide, $In_7O_9=3InO, 2In_2O_3$ (?). (Winkler.)

$In_4O_5=2InO, In_2O_3$ (?). (Winkler.)

Indium oxybromide (?).

Not decomp. by hot acids or alkalies. (Meyer, A. **150.** 137.)

Indium oxychloride.

Insol. in H_2O.

Indium sulphide, In_2S_3.

Partially sol. in $(NH_4)_2S+Aq$.

Indium potassium sulphide, In_2S_3, K_2S.

Insol. in H_2O; decomp. by weak acids with separation of In_2S_3; sol. in conc. acids. (Schneider, J. pr. (2) **9.** 209.)

Indium silver sulphide, In_2S_3, Ag_2S.

Insol. in H_2O. (Schneider, *l.c.*)

Indium sodium sulphide, In_2S_3, Na_2S+2H_2O.

Insol. in H_2O. (Schneider, *l.c.*)

Infusible white precipitate.

See **Mercuric chloramide.**

*Di*iodamine, NHI_2.

Decomp. by H_2O.

Iodammonium iodide, NIH_3I.

Decomp. by H_2O, caustic alkalies, and acids. Sol. in $KI+Aq$, alcohol, ether, CS_2, $CHCl_3$. (Guthrie, Chem. Soc. (2) **1.** 239.)

Iodauric acid, $HAuI_4$ (?).

Not known with certainty.

Ammonium iodaurate.

Deliquescent. Decomp. by H_2O. (Johnston, Phil. Mag. (3) **9.** 266.)

Barium iodaurate.

Sol. in BaI_2 + Aq.

Ferrous iodaurate.

Sol. in H_2O. (Johnston.)

Potassium iodaurate, $KAuI_4$.

Decomp. by H_2O. Sol. in KI, and HI + Aq. (Johnston.)

Sodium iodaurate.

Very deliquescent. (Johnston.)

Iodauricyanhydric acid, $HAu(CN)_2I_2$.

Known only in its salts.

Barium iodauricyanide, $Ba[Au(CN)_2I_2]_2 + 10H_2O$.

Sl. sol. in cold, easily in hot H_2O. Easily sol. in alcohol. (Lindbom, Lund. Univ. Arsk. **12.** No. 6.)

Calcium iodauricyanide, $Ca[Au(CN)_2I_2]_2 + 10H_2O$.

Not stable. (L.)

Cobalt iodauricyanide, $Co[Au(CN)_2I_2]_2 + 10H_2O$.

Most insol. of all iodauricyanides, and only sl. sol. in warm H_2O. Easily sol. in alcohol.

Potassium iodauricyanide, $KAu(CN)_2I_2 + H_2O$.

Sl. sol. in cold, easily sol. in warm H_2O and alcohol. (L.)

Strontium iodauricyanide, $Sr[Au(CN)_2I_2]_2 + 10H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

Iodhydric Acid, HI.

Very easily and quickly absorbed by H_2O, with evolution of much heat.

Solution is decomp. on exposure to the air.

1 vol. H_2O absorbs 450 vols. HI at 10°. (Thomson.)

1 vol. H_2O absorbs 425 vols. HI at 10°. (Berthelot, C. R. **76.** 679.)

Solution in H_2O sat. at 0° has sp. gr. = 1·99 (de Luynes, A. ch. (4) **2.** 385); 2·0 (Vigier).

Weak or strong solutions when boiled in an atmosphere of H leave a residue of constant composition, which distils unchanged at 126° (de Luynes), at 127° (Roscoe, Chem. Soc. **13.** 146; Naumann; Topsoë), at 128° (Bineau, A. ch. (3) **7.** 266); and has a sp. gr. of 1·67 (Naumann), of 1·70 (Bineau, de Luynes), of 1·708 (Topsoë); and contains 56·26 % HI (Bineau), 57·0 % HI (Roscoe), 57·75 % HI (Topsoë).

By conducting dry H gas through the aqueous solution of HI, a constant residue is obtained, containing 60·3-60·7 % HI if temp. is 15-19°, and 58·2-58·5 % HI if temp. is 100°. (Roscoe.)

Sp. gr. of HI + Aq.

Sp. gr.	% HI	Temp.
1·017	2·286	13·5°
1·0524	7·019	13·5
1·077	10·15	13·5
1·095	12·21	13
1·102	13·09	13·5
1·126	15·73	13·5
1·164	19·97	13·5
1·191	22·63	13·8
1·225	25·86	13·8
1·2535	28·41	13·5
1·274	30·20	13·5
1·309	33·07	13
1·347	36·07	13
1·382	38·68	13
1·413	40·45	13
1·451	43·39	13
1·4865	45·71	13
1·528	48·22	13
1·542	49·13	13·5
1·5727	50·75	13
1·603	52·43	12·5
1·630	53·93	14
1·674	56·15	13·7
1·696	57·28	13
1·703	57·42	12·5
1·706	57·64	13·7
1·708	57·74	12

(Topsoë, B. **3.** 403.)

Sp. gr. of HI + Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
1	1·008	21	1·175	41	1·414
2	1·015	22	1·185	42	1·429
3	1·022	23	1·195	43	1·444
4	1·029	24	1·205	44	1·459
5	1·037	25	1·216	45	1·475
6	1·045	26	1·227	46	1·491
7	1·053	27	1·238	47	1·508
8	1·061	28	1·249	48	1·525
9	1·069	29	1·260	49	1·543
10	1·077	30	1·271	50	1·561
11	1·085	31	1·283	51	1·579
12	1·093	32	1·295	52	1·597
13	1·102	33	1·307	53	1·615
14	1·110	34	1·320	54	1·634
15	1·118	35	1·333	55	1·654
16	1·127	36	1·346	56	1·674
17	1·137	37	1·359	57	1·694
18	1·146	38	1·372	58	1·713
19	1·155	39	1·386	...	...
20	1·165	40	1·400	...	...

(Topsoë, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HI + Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
5	1·045	25	1·239	45	1·533
10	1·091	30	1·296	50	1·650
15	1·138	35	1·361	52	1·700
20	1·187	40	1·438	...	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. **23.** 253.)

Iodic acid, HIO_3.

Very sol. in H_2O and alcohol.

Sat. solution has sp. gr. 2·842 at 12·5°, and boils at 104°. (Ditte, B. **6.** 1533.) Sat. solution has sp. gr. 2·1629 (1·874 pts. I_2O_5 in 1 pt. H_2O) at 13°, and boils at 100°. (Kämmerer, Pogg. **138.** 400.)

Sp. gr. of HIO_3+Aq at 15°.

% I_2O_5	Sp. gr.	% I_2O_5	Sp. gr.
1	1·0053	35	1·4428
5	1·0263	40	1·5371
10	1·0525	45	1·6315
15	1·1223	50	1·7356
20	1·2093	55	1·8689
25	1·2773	60	1·9954
30	1·3484	65	2·1269

(Kämmerer.)

According to Thomsen (B. **7.** 71) solutions of HIO_3 have sp. gr.—

$HIO_3 + 10H_2O = 1·6609$.
$HIO_3 + 20H_2O = 1·3660$.
$HIO_3 + 40H_2O = 1·1945$.
$HIO_3 + 80H_2O = 1·1004$.
$HIO_3 + 160H_2O = 1·0512$.
$HIO_3 + 320H_2O = 1·0258$.

H_2SO_4 at nearly boiling temp. dissolves $\frac{1}{3}$ its weight of iodic acid. (Millon.)

Insol. in absolute alcohol. Alcohol of 35° B. dissolve half its weight in HIO_3. (Kämmerer.)

$+4\frac{1}{2}H_2O$.

Iodates.

The alkali iodates are sol. in H_2O, the others are sl. sol. or insol. therein.

Aluminum iodate, $Al(IO_3)_3$ (?).

Deliquescent. (Berzelius.)

Ammonium iodate, NH_4IO_3.

Sl. sol. in H_2O. Sol. in 38·5 pts. H_2O at 15°, 6·9 pts. at 100°. (Rammelsberg, Pogg. **44.** 555.)

$+H_2O$. (Ditte, A. ch. (6) **21.** 146.)

Ammonium *di*iodate, $NH_4H(IO_3)_2$.

Sl. sol. in cold H_2O. (Ditte, A. ch. (6) **21.** 145.)

Ammonium *tri*iodate, $NH_4H_2(IO_3)_3$.

Sol. in H_2O. (Blomstrand, J. pr. (2) **42.** 335.)

Ammonium cobalt iodate.

Decomp. by H_2O. Insol. in alcohol. (Rammelsberg.)

Ammonium oxy*di*mercuriammonium iodate.

See **Oxy*di*mercuriammonium ammonium iodate.**

Barium iodate, $Ba(IO_3)_2+H_2O$.

Sol. in 3333 pts. H_2O at 18°, and 625 pts. H_2O at 100°. (Gay-Lussac, A. ch. **91.** 5.)

Anhydrous salt is sol. in 1746 pts. H_2O at 15°, and 600 pts. H_2O at 100° (Rammelsberg, Pogg. **44.** 577); in 3018 pts. H_2O at 13·5°, and 681 pts. H_2O at 100°. (Kremers, Pogg. **84.** 27.)

Easily sol. in cold HCl+Aq; difficultly sol. in warm HNO_3+Aq. (Rammelsberg.)

Insol. in H_2SO_4. (Ditte.)

Insol. in alcohol.

Bismuth iodate, basic.

Insol. in H_2O. Very difficultly sol. in HNO_3+Aq. (Rammelsberg, Pogg. **44.** 568.)

$Bi(IO_3)_3+1\frac{1}{2}H_2O$. Insol. in H_2O.

Cadmium iodate, $Cd(IO_3)_2$.

Very sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. Sol. in $Cd(C_2H_3O_2)_2$+Aq. (Rammelsberg, Pogg. **44.** 566.)

$+H_2O$. Sl. sol. in H_2O. Very sol. in dil. HNO_3+Aq. (Ditte, A. ch. (6) **21.** 145.)

Cadmium iodate ammonia, $Cd(IO_3)_2, 2NH_3$.

Insol. in H_2O; sol. in NH_4OH+Aq. (Ditte, A. ch. (6) **21.** 145.)

$Cd(IO_3)_2, 2NH_3+H_2O$. As above. (Ditte.)

Cæsium iodate, $CsIO_3$.

100 pts. H_2O dissolve 2·6 pts. $CsIO_3$ at 24°. Insol. in alcohol. (Wheeler, Sill. Am. J. **144.** 123.)

$2CsIO_3, I_2O_5$. 100 pts. H_2O dissolve 2·5 pts. at 21°. Not decomp. by hot H_2O. (Wheeler.)

$2CsIO_3, I_2O_5, 2HIO_3$. Sl. sol. in cold H_2O, and decomp. thereby into $2CsIO_3, I_2O_5$. (Wheeler.)

Cæsium iodate chloride, $CsCl, HIO_3$.

Decomp. by H_2O into $2CsIO_3, I_2O_5$. (Wheeler.)

Calcium iodate, $Ca(IO_3)_2$.

100 pts. H_2O dissolve 0·22 pt. at 18°, and 0·986 pt. at 100°. (Gay-Lussac.) Sol. in conc. HCl+Aq. (Filhol.) Much more sol. in HNO_3+Aq than in H_2O. (Rammelsberg.) Insol. in H_2SO_4. (Ditte.) Scarcely sol. in sat. KIO_3+Aq. (Sonstadt, C. N. **29.** 209.)

+4, or $6H_2O$. Efflorescent.

Sol. in 253 pts. H_2O at 15°, and 75 pts. at 100°. (Rammelsberg.)

Much more sol. in HNO_3+Aq. Pptd. by alcohol from $Ca(IO_3)_2$+Aq.

Insol. in H_2SO_4. (Ditte.)

Cerous iodate, $Ce(IO_3)_3+2H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O and in acids. (Holzmann, J. pr. **75.** 321.)

Cobaltous iodate, $Co(IO_3)_2$.

Anhydrous. Sol. in warm dil. H_3PO_4, or H_2SO_4+Aq. (Ditte, A. ch. (6) **21.** 145.)

$+H_2O$. Sol. in 148 pts. H_2O at 15°, and 90 pts. at 100°. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **44.** 561.)

+2, 3, 4, and $5H_2O$. (Ditte.)

$+6H_2O$. (Clarke, Sill. Am. J. (3) **14.** 280.)

Cupric iodate, basic, $6CuO, 3I_2O_5+2H_2O$.

Insol. in H_2O. (Millon, A. ch. (3) **9.** 400.)

Mixture of CuO and $Cu(IO_3)_2$. (Ditte, A. ch. (6) **21.** 175.)

Cupric iodate, $Cu(IO_3)_2$.

Anhydrous. (Ditte, A. ch. (6) **21.** 145.)
$+H_2O$. (Ditte.)
$+2H_2O$. Sol. in 302 pts. H_2O at 15°, and 154 pts. at 100°. Sol. in $HCl+Aq$ or NH_4OH+Aq. (Millon.)

Cupric iodate ammonia, $Cu(IO_3)_2, 2NH_3+H_2O$.

Insol. in H_2O. (Ditte, A. ch. (6) **21.** 145.)

$Cu(IO_3)_2, 4NH_3+3H_2O$. Partially sol. in H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol. (Rammelsberg.)

$Cu(IO_3)_2, 8NH_3+4H_2O$. Sol. in H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol. (Ditte, A. ch. (6) **21.** 145.)

Decipium iodate, $Dp(IO_3)_3+3H_2O$ (?).

Precipitate; scarcely sol. in H_2O. (Delafontaine.)

Didymium iodate, $Di(IO_3)_3+2H_2O$.

Ppt. (Cleve.)

Erbium iodate, $Er(IO_3)_3+3H_2O$.

Very sl. sol. in H_2O. (Höglund.)

Glucinum iodate.

Deliquescent.

Ferrous iodate.

Ppt. Sl. sol. in H_2O; more sol. in $FeSO_4+Aq$. (Geiger, Mag. Pharm. **29.** 252.)

Ferric iodate, Fe_2O_3, I_2O_5.

Insol. in acids. (Ditte, A. ch. (6) **21.** 145.)

$Fe_2O_3, 2I_2O_5+8H_2O$. Sol. in 500 pts. H_2O. Difficultly sol. in HNO_3+Aq. Sol. in $FeCl_3+Aq$. (Geiger.)

$3Fe_2O_3, 5I_2O_5+15H_2O$. Sol. in HCl, or HNO_3+Aq. (Rammelsberg.)

Lanthanum iodate, $La(IO_3)_3+1\frac{1}{2}H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. Very sol. in warm $HCl+Aq$. (Holzmann, J. pr. **75.** 349.)

Lead iodate, $Pb(IO_3)_2$.

Very sl. sol. in H_2O (Pleischl), and difficultly sol. in HNO_3+Aq. (Rammelsberg.)

Insol. in H_2O and H_2SO_4+Aq. Very sl. sol. in HNO_3+Aq, and wholly insol. therein after being heated to 100°. (Ditte, A. ch. (6) **21.** 169.)

Lithium iodate, $LiIO_3+\frac{1}{2}H_2O$.

Deliquescent, and very sol. in H_2O.

Sol. in 2 pts. cold, and not much less hot H_2O. Insol. in alcohol. (Rammelsberg, Pogg. **44.** 555.

$+H_2O$. Very deliquescent. (Ditte, A. ch. (6) **21.** 145.)

Magnesium iodate, $Mg(IO_3)_2$.

Anhydrous. Insol. in H_2O. (Millon, A. ch. (3) **9.** 422.)
$+4H_2O$. Very sol. in H_2O. (Ditte.)
Sol. in 9·43 pts. H_2O at 15°, and 3·04 pts. at 100°. (Berzelius.) Very sl. sol. in H_2O. (Serullas, A. ch. **45.** 279.) Easily sol. in dil. H_2SO_4+Aq. (Ditte.)

Manganous iodate, $Mn(IO_3)_2+H_2O$.

Sol. in about 200 pts. H_2O. (Rammelsberg.) Insol. in H_2O and HNO_3+Aq, even on boiling. Insol. in NH_4OH+Aq. (Ditte.)

Mercurous iodate, $Hg_2(IO_3)_2$.

Insol. in boiling H_2O, or cold HNO_3+Aq. Easily sol. in dil. $HCl+Aq$. Sol. in very conc. HIO_3+Aq. (Lefort, J. Pharm. **1845.** 5.)

Mercuric iodate, $Hg(IO_3)_2$.

Insol. in H_2O or alcohol. (Millon, A. ch. (3) **18.** 367.) Sol. in H_2O. (Berzelius.) Sol. in dil. $HCl+Aq$. (Rammelsberg.)

Nearly insol. in H_2O. Easily sol. in HCl, HBr, or $HI+Aq$; very sl. sol. in HNO_3+Aq; insol. in HF, H_2SiF_6, or $HC_2H_3O_2+Aq$. Sol. in alkali chlorides, bromides, iodides, cyanides, and cyanates $+Aq$; also in $Na_2S_2O_3$, dil. $MnCl_2$, and $ZnCl_2+Aq$. Insol. in KOH, NaOH, NH_4OH, Na_2S, $Na_2B_4O_7$, Na_2HPO_4, and the alkali chlorates, bromates, and iodates $+Aq$. (Cameron, C. N. **33.** 253.)

Nickel iodate, $Ni(IO_3)_2+H_2O$.

Sol. in 120·3 pts. H_2O at 15°, and 77·35 pts. at 100°. (Rammelsberg, Pogg. **44.** 562.)
Sol. in HNO_3, and dil. H_2SO_4+Aq. (Ditte.)
Sol. in NH_4OH+Aq.
$+3H_2O$. (Ditte, A. ch. (6) **21.** 145.)
$+6H_2O$. (Clarke, Sill. Am. J. (3) **14.** 280.)

Nickel iodate ammonia, $Ni(IO_3)_2, 4NH_3$.

Sol. in NH_4OH+Aq. Insol. in alcohol. (Rammelsberg, Pogg. **44.** 562.)

Potassium iodate, KIO_3.

1 pt. KIO_3 dissolves in 13 pts. H_2O at 14°. (Gay-Lussac.)

1 pt. KIO_3 dissolves at:

0°	in	21·11	pts. H_2O
20°	,,	12·29	,,
40°	,,	7·76	,,
60°	,,	5·40	,,
80°	,,	4·02	,,
100°	,,	3·10	,,

Sat. solution boils at 102°. (Kremers, Pogg. **97.** 5.)

Sp. gr. of KIO_3+Aq containing:

1	2	3	4	5	% KIO_3,
1·010	1·019	1·027	1·035	1·044	
6	7	8	9	10	% KIO_3.
1·052	1·061	1·071	1·080	1·090	

(Kremers, Pogg. **96.** 62.)

More sol. in $KI+Aq$ than in H_2O. Sol. in warm H_2SO_4+Aq. Insol. in alcohol.
$+\frac{1}{2}H_2O$. (Ditte, C. R. **70.** 621.)

Potassium hydrogen iodate, $KH(IO_3)_2$.

Sol. in 18·65 pts. H_2O at 17°. (Meineke, A. **261.** 360.)

Sol. in 75 pts. H_2O at 15°. Insol. in alcohol. (Serullas, A. ch. **22.** 181.)

Potassium *di*hydrogen iodate, $KH_2(IO_3)_3$.

Sol. in 25 pts. H_2O at 15°. (Serullas, A. ch. **43.** 117.)

Potassium iodate chloride, $KH(IO_3)_2, 2KCl$.

Sol. in 19 pts. H_2O at 15° with decomp. Cold alcohol dissolves out KCl.

Potassium iodate molybdate, KIO_3, MoO_3+2H_2O.

See **Molybdatoiodate, potassium.**

Potassium iodate sulphate, KIO_3, $KHSO_4$.

Decomp. by H_2O. (Marignac, J. B. **1856.** 299.)

$KHIO_3$, $KHSO_4$. More sol. in H_2O than $KHIO_3$. (Serullas.)

Potassium iodate tungstate.

See **Tungstoiodate, potassium.**

Rubidium iodate, $RbIO_3$.

100 pts. H_2O dissolve 2·1 pts. $RbIO_3$ at 23°. Easily sol. in cold $HCl+Aq$. (Wheeler, Sill. Am. J. **144.** 123.)

Rubidium hydrogen iodate, $RbH(IO_3)_2$.

Sl. sol. in cold, more readily in hot H_2O, $RbIO_3$ separating on cooling. Insol. in alcohol. (Wheeler.)

$RbH_2(IO_3)_3$. As above. (Wheeler.)

Rubidium iodate chloride, $RbIO_3$, HCl, or HIO_3, $RbCl$.

Decomp. by cold H_2O. (Wheeler.)

$3RbCl$, $2HIO_3$. Sol. in H_2O, from which $RbIO_3$ separates. (Wheeler.)

Samarium iodate, $Sm(IO_3)_3+6H_2O$.

Precipitate. (Cleve.)

Silver iodate, $AgIO_3$.

Not completely insol. in H_2O. (Rose.) Sol. in NH_4OH+Aq; sol. in HNO_3+Aq. (Naquet, J. B. **1860.** 201.) Sol. in conc. $KI+Aq$. (Ladenburg, A. **135.** 1.)

Sol. in 27,700 pts. H_2O at 25°; in 42·4 pts. 5 % NH_4OH+Aq at 25°; in 2·1 pts. 10 % NH_4OH+Aq at 25°; in 1044·3 pts. 35 % HNO_3+Aq (sp. gr. 1·21) at 25°. (Longi, Gazz. ch. it. **13.** 87.)

Silver iodate ammonia, $2AgIO_3$, $3NH_3+1\frac{1}{2}H_2O$.

Very sol. in cold H_2O. (Ditte, A. ch. (6) **21.** 145.)

Sodium iodate, $NaIO_3$.

100 pts. H_2O dissolve 7·25 pts. $NaIO_3$ at 14·5°. (Gay-Lussac.) 100 pts. H_2O dissolve 2·52 pts. at 0°; 9·07 pts. at 20°; 14·39 pts. at 60°; 27·7 pts. at 80°; 33·9 pts. at 100°. (Kremers, Pogg. **97.** 5.) Sat. solution boils at 102° (Kremers), 105° (Ditte).

Insol. in alcohol. Sol. in dil. $HC_2H_3O_2+Aq$. Cryst. with $1H_2O$, $1\frac{1}{2}H_2O$, $2H_2O$, $3H_2O$, $5H_2O$, $6H_2O$, and $8H_2O$.

Sodium hydrogen iodate.

Very soluble gummy mass. (Millon, A. ch. (3) **9.** 418.)

$NaIO_3$, $2HIO_3+\frac{1}{2}H_2O$. Very sol. in H_2O. (Blomstrand, J. pr. (2) **42.** 337.)

Sodium iodate bromide, $NaIO_3$, $2NaBr+9H_2O$.

Sol. in H_2O. (Rammelsberg.)

Sodium iodate chloride, $NaIO_3$, $NaCl+4H_2O$, and $2NaIO_3$, $3NaCl+18H_2O$.

Cold H_2O dissolves out NaCl.

Sodium iodate iodide, $NaIO_3$, NaI.

Hot H_2O or alcohol dissolves out NaI.

$+8H_2O$.

$+10H_2O$.

$2NaIO_3$, $3NaI+20H_2O$. (Penny, A. **37.** 202.)

Strontium iodate, $Sr(IO_3)_2$.

Anhydrous. Insol. in H_2SO_4 (Ditte); easily sol. in cold $HCl+Aq$. (Rammelsberg, Pogg. **44.** 575.)

$+H_2O$. Difficultly sol. in H_2O.

$+6H_2O$. Sol. in 416 pts. H_2O at 15°, and 138 pts. at 100° (Gay-Lussac); 342 pts. at 15°, and 110 pts. at 100°. Difficultly sol. in warm HNO_3+Aq. (Rammelsberg, Pogg. **44.** 575.)

Thallous iodate, $TlIO_3$.

Difficultly sol. in warm H_2O. (Oettinger.)

Insol. in H_2O; difficultly sol. in HNO_3+Aq. (Rammelsberg.)

Sol. in a little NH_4OH+Aq, also in boiling HNO_3, H_2SO_4, or $HCl+Aq$. Insol. in alcohol. (Oettinger.)

$+\frac{1}{2}H_2O$. Very sl. sol. in H_2O or dil. boiling acids. (Ditte, A. ch. (6) **21.** 145.)

Thallic iodate, basic, $Tl(OH)(IO_3)_2+H_2O=Tl_2O_3$, $2I_2O_5+3H_2O$.

Insol. in H_2O; sol. in cold $HCl+Aq$, and warm dil. H_2SO_4+Aq. (Ditte, A. ch. (6) **21.** 145.)

Thallic iodate, $Tl_2(IO_3)_6+3H_2O$.

Insol. in H_2O; sl. sol. in HNO_3+Aq. Decomp. by alkalies. (Rammelsberg.)

Thorium iodate, $Th(IO_3)_4$.

Precipitate. (Cleve.)

Stannous iodate.

Ppt. Sol. in $SnCl_2+Aq$; insol. in $NaIO_3+Aq$.

Stannic iodate.

Ppt.

Uranous iodate.

Precipitate. Very unstable. (Rammelsberg.)

Uranyl iodate, $UO_2(IO_3)_2$.

Sol. or insol. in HNO_3 and H_3PO_4+Aq, according to method of preparation. (Ditte.)

$+H_2O$. Sl. sol. in HNO_3+Aq. (Rammelsberg.)

Yttrium iodate, $Y(IO_3)_3+3H_2O$.

Sol. in 190 pts. H_2O. (Berlin.)

Zinc iodate, $Zn(IO_3)_2$.

Anhydrous. (Ditte, A. ch. (6) **21.** 145.)

$+2H_2O$. Sol. in 114 pts. cold, and 76 pts. hot H_2O. (Rammelsberg, Pogg. **43.** 665.)

Sol. in HNO_3, and NH_4OH+Aq.

Zinc iodate ammonia, $3Zn(IO_3)_2$, $8NH_3$.

Decomp. by H_2O; sol. in NH_4OH+Aq, from which it is pptd. by alcohol. (Rammelsberg, Pogg. **44.** 563.)

$Zn(IO_3)_2$, $2NH_3$. Insol. in H_2O. (Ditte, A. ch. (6) **21.** 145.)

$Zn(IO_3)_2$, $3NH_3+H_2O$. Insol. in H_2O. (Ditte.)

*Per*iodic acid.

See **Periodic acid.**

Iodides.

The iodides are in general easily sol. in H_2O; exceptions are HgI_2, PbI_2, AgI, Cu_2I_2, and BiI_3, also the iodides of the Pt metals, all of which are insol. SnI_4, SbI_3, and TlI_3 are decomp. by H_2O. Many iodides are more sol. in solutions of salts than in H_2O, and several are sol. in alcohol or ether.

See under each element.

Iodine, I_2.

Sol. in 5524 pts. H_2O at 0-12°. (Wittstein, J. B. **1857**. 123.)

Sol. in 7000 pts. H_2O. (Gay-Lussac.)

Sol. in 3800 pts. H_2O at 15°. (Basse.)

Sol. in 500 pts. H_2O. (Jacquelain.)

Sol. in 7196·4 pts. H_2O at 18·75°. (Abl.)

Pure H_2O dissolves 0·01519173 g. I per litre, or sol. in 6582 pts. H_2O at 6·3°. (Dossius and Weith, Zeit. Ch. **12**. 378.)

Sol. in about 4500 pts. H_2O. (Hager, Comm. **1883**.)

Sol. in 7000 pts. H_2O. (Cap and Garot, J. Pharm. (3) **26**. 80.)

Conc. H_2SO_4, HCl, HNO_3, H_3PO_4, $HC_2H_3O_2$, tartaric, or citric acids + Aq dissolve I, but give it up to CS_2 on shaking therewith. (Tessier, Z. anal. **11**. 313.)

Sol. in 150 pts. H_2SO_4 on warming, but crystallises out in part on cooling. (Kraus.)

Much more sol. in HBr + Aq than in pure H_2O; HBr + Aq of sp. gr. 1·486 dissolves 3-4 %. (Bineau.)

Sl. sol. in HCl + Aq. Easily sol. in even dil. HI + Aq.

Sol. in H_2SO_3 + Aq with decomp.

Sol. in solutions of soluble iodides.

100 pts. KI + 200 pts. H_2O dissolve 153 pts. I; from this solution H_2O precipitates ½ the dissolved I. 100 pts. KI + 400 pts. H_2O dissolve quickly 76·5 pts. I. If more water is present, the solution takes place more slowly. (Baup.)

CS_2 extracts the I from the above solutions.

Table of solubility of I in KI + Aq at 7-7·3°.

% KI in KI + Aq	Pts. I dissolved	Sp. gr. of solution
1·802	1·173	1·0234
3·159	2·303	1·0433
4·628	3·643	1·0668
5·935	4·778	1·0881
7·201	6·037	1·1112
8·663	7·368	1·1382
10·036	8·877	1·1637
11·034	9·949	1·1893
11·893	11·182	1·2110
12·643	12·060	1·2293

(Dossius and Weith, Zeit. Ch. (2) **5**. 379.)

100 pts. $AsCl_3$ dissolve 8·42 pts. I at 0°; 11·88 pts. I at 15°; 36·89 pts. I at 96°. (Sloan, C. N. **46**. 194.)

Easily sol. in boiling dil. $HgCl_2$ + Aq. (Selmi.)

Sol. in liquid SO_2 (Sestini), and SO_3 (Weber).

Sol. in 10-12 pts. alcohol. (Wittstein.)

Sol. in wood-spirit. (Playfair.)

Abundantly sol. in amyl (Pelletan), and hexyl alcohol (Bouis).

Very sol. in ether, chloroform, and bromoform.

Easily sol. in hot, less in cold naphtha. (Pelletier and Walker.)

Sol. in about 8 pts. hot petroleum from Amiano. (de Saussure.)

Sl. sol. in cold, more readily in hot benzene. (Mansfield.) Easily sol. in benzene. (Moride, A. ch. (3) **39**. 452.)

Easily sol. in oil of turpentine, but an explosion soon occurs. (Walker.)

Sol. in oil of mandarin. (Luca.)

Sol. in oil of arnica-root. (Zeller.)

Very sol. in CS_2, lignone, furfurol, glycerine, aldehyde, chloral, warm retinole, toluene, salicylic acid, methyl nitrate, methyl salicylate, mercaptan, amyl carbamate, ethyl sulphydrate, allyl iodide, ethyl disulphocarbonate, carbon chloride, SCl_2, ICl_3, H_2S_5, chlorochromic acid, amyl valerianate, valerianic acid, warm butyric acid, creosote, aniline, quinoline, methylsalicylic acid. Quickly sol. in oil of dill, peppermint, sassafras, and tansy. Slowly sol. in oil of cloves, cinnamon, cajeput, and rue. Other essential oils decompose it. (Various authorities.)

1 mol. KI in alcohol dissolves 2 atoms I, and the solution does not give up I to CS_2. (Jörgensen, J. pr. (2) **2**. 347.)

Iodine is sol. in 20 pts. alcohol, 110 pts. oil, 7000 pts. H_2O, 100 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26**. 80.)

About as sol. in all fatty oils as in $CHCl_3$, etc. (Greul, Arch. Pharm, **223**. 431.)

Sol. in 56·6 pts. chloroform at 10°. (Duncan, Pharm. J. Trans. **51**. 544.)

Very sol. in methylene iodide. (Retgers, Z. anorg. **3**. 343.)

When an aqueous solution of I is shaken with CS_2, 400 pts. go into solution in CS_2 for 1 pt. remaining in H_2O. (Berthelot and Jungfleisch, C. R. **69**. 338.)

Sol. in potassium croconate + Aq. (Gmelin.)

Sol. in potassium antimony tartrate + Aq. 176 pts. H_2O + 6 pts. potassium antimony tartrate dissolve 2·75 pts. I; 378 pts. H_2O + 6 pts. potassium antimony tartrate dissolve 4·12 pts. I.

More sol. in tannic acid than in H_2O. 1 pt. I is sol. in 450 pts. H_2O with 3·3 pts. tannic acid at 12°; 1 pt. I is sol. in 240 pts. H_2O with 0·015 pt. tannic acid at about 30°. (Koller, Zeit. Ch. **1866**. 380.)

200 g. H_2O containing 0·3 g. tannic acid dissolve 1·0 g. I. (Hager, Comm. **1883**.)

Sol. in considerable quantity, especially on warming, in resorcin, orcin, or phloroglucin + Aq, without coloration or formation of HI + Aq. These solutions withdraw I from CS_2 solution, and do not give it up on boiling, but on evaporation in vacuo the I is sublimed in a pure state. (Hlasiwetz, Z. anal. **6**. 447.\

Iodine *mono*bromide, IBr.

Slowly sol. in H_2O with slight decomp. Sol. in $CHCl_3$, CS_2, ether, and alcohol.

$+5H_2O$. (Löwig, Pogg. **14.** 485.) Does not exist. (Bornemann, A. **189.** 183.)

Iodine *penta*bromide, IBr_5 (?).

Sol. in H_2O with separation of iodine. (Löwig, Pogg. **14.** 485.)

Iodine *mono*chloride, ICl.

Decomp. by H_2O; sol. without decomp. in alcohol, ether, and HCl+Aq.

Sol. in CS_2.

Iodine hydrogen chloride, ICl, HCl.

Unstable. Sol. in ether. (Schützenberger, C. R. **84.** 389.)

Iodine *tri*chloride, ICl_3.

Deliquescent. With H_2O, a part is dissolved without decomp., and the rest is decomp. The aqueous solution contains more unchanged ICl_3, the more conc. it is. (Serullas.) Precipitated from aqueous solution by H_2SO_4. Sol. in HCl+Aq. Sol. in warm conc. H_2SO_4 without decomp. Sol. in alcohol, and benzene. Decomp. by small amount of CS_2. (Christomanos, B. **10.** 434.) Ether does not remove it from aqueous solution. (Serullas.)

Iodine lithium chloride, ICl_3, $LiCl+4H_2O$.

See **Lithium chloroiodide.**

Iodine *tri*chloride magnesium chloride, $2ICl_3$, $MgCl_2+5H_2O$.

Very deliquescent and easily decomposed. (Filhol, J. Pharm. **25.** 442.)

Iodine *mono*chloride phosphorus *penta*chloride, ICl, PCl_5.

Very deliquescent; decomp. by H_2O.

Iodine potassium chloride, ICl_3, KCl.

Sol. in H_2O with decomp.

Ether dissolves out ICl_3. (Filhol, J. Pharm. **25.** 433, 506.)

See **Potassium chloroiodide.**

Iodine sodium chloride, ICl_3, $NaCl+2H_2O$.

See **Sodium chloroiodide.**

Iodine *tri*chloride sulphur *tetra*chloride, ICl_3, SCl_4.

Very deliquescent in air; decomp. by H_2O. Decomp. with formation of clear solution by dil. HNO_3+Aq. (Weber, Pogg. **128.** 459.)

SCl_2, $2ICl_3$. (Jaillard, J. B. **1860.** 95.)

Correct formula is as above. (Weber, *l.c.*)

Iodine *penta*fluoride.

Fumes on air; decomp. with H_2O. (Gore, C. N. **24.** 291.)

Iodine *tri*oxide, I_2O_3.

Decomp. by H_2O. (Ogier, C. R. **85.** 957; **86.** 722.)

Probably a mixture.

Iodine *tetr*oxide, I_2O_4 (?).

Insol. in cold, decomp. by hot H_2O; insol. in alcohol. Decomp. by HNO_3+Aq. Sol. in H_2SO_4. (Millon, J. pr. **34.** 319, 337.)

Iodine *pent*oxide, I_2O_5.

Very sol. in H_2O, and in dil. alcohol. Insol. in absolute alcohol, ether, CS_2, chloroform, and hydrocarbons.

Forms hydrates, iodic acid HIO_3, and $3I_2O_5$, H_2O; insol. in ordinary alcohol. For sp. gr. of aqueous solution, see ***iodic acid.***

Iodine oxides, $I_{10}O_{19}$, I_3O_{13}.

The compounds, $I_{10}O_{19}$ (Millon, J. pr. **34.** 336), and I_3O_{13} (Kämmerer, J. pr. **83.** 81), are probably mixtures.

Iodine sulphur oxide, $5I_2O_5$, SO_3.

Decomp. by H_2O. (Kämmerer.)

I_2O_5, $3SO_3$. Decomp. by H_2O; sl. sol. in hot SO_3. (Weber, B. **20.** 86.)

$=(IO)_2(SO_4)_3$. Iodyl sulphate (?).

Iodine sulphoxide, I_2SO_3 (?).

Decomp. by H_2O. (Schultz-Sellack.)

$I_2(SO_3)_2$ (?). Decomp. by H_2O. (Weber, J. pr. (2) **25.** 224.)

$I_2(SO_3)_6$ (?). As above. (Weber.)

See also **Iodosulphuric anhydride.**

Iodiridic acid.

Ammonium iodiridate, $(NH_4)_2IrI_6$.

Very easily sol. in cold H_2O, decomp. on warming. Insol. in alcohol. (Oppler, J. B. **1857.** 263.)

Potassium iodiridate, K_2IrI_6.

Very easily sol. in H_2O. Insol. in alcohol.

Sodium iodiridate, Na_2IrI_6.

Insol. in cold, sl. sol. in hot H_2O. Easily sol. in acids. (Oppler.)

Iodiridous acid.

Ammonium iodiridite, $(NH_4)_6Ir_2I_{12}+H_2O$.

Very sol. in H_2O, but decomp. on warming. (Oppler.)

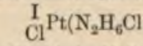
Potassium iodiridite, $K_6Ir_2I_{12}$.

Insol. in H_2O, or alcohol. Slowly sol. in acids; easily in warm alkalies +Aq.

Silver iodiridite, $Ag_6Ir_2I_{12}$.

Ppt.

Iodochloroplatin*di*amine chloride,



$$\overset{I}{\underset{Cl}{}}Pt(N_2H_6Cl)_2.$$

Sl. sol. in H_2O.

Iodochromic acid.

Potassium iodochromate, $KCrO_3I$.

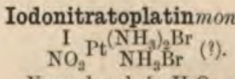
Decomp. by boiling H_2O. (Guyot, C. R. **73.** 46.)

See also **Chromoiodic acid.**

Iodomolybdic acid.

See **Molybdoiodic acid.**

Iodonitratoplatin*monodi*amine bromide,



$$\overset{I}{\underset{NO_2}{}}Pt\overset{(NH_3)_2Br}{\underset{NH_3Br}{}}\ (?).$$

Very sl. sol. in H_2O. (Cleve.)

Iodonitritoplatin*di*amine nitrate, $I(NO_2)Pt(N_2H_6)_2(NO_3)_2$.
Quite easily sol. in hot H_2O. (Cleve.)

Iodopalladous acid.

Potassium iodopalladite.
Deliquescent. (Lassaigne.)

Iodoplatinamine iodide, $I_2Pt(NH_3I)_2$.
Sol. in H_2O, especially easily if boiling. (Cleve.)

Iodoplatin*di*amine iodide, $I_2Pt(N_2H_6I)_2$.
Sol. in H_2O, especially when hot. (Cleve.)

—— **mercuric iodide,** $I_2Pt(N_2H_6I)_2, 2HgI_2$.
Extremely difficultly sol. in cold H_2O; partly decomp. by boiling. (Jörgensen, Gm. K. **3**. 1214.)

—— **nitrate,** $I_2Pt(N_2H_6NO_3)_2$.
More sol. in hot than cold H_2O.

—— **sulphate,** $I_2Pt(N_2H_6)_2SO_4$.
Very sl. sol. in H_2O. (Jörgensen, J. pr. (2) **15**. 429.)

Iodoplatin*semidi*amine iodide, $I_3Pt(NH_3)_2I$ (?).
Sl. sol. in H_2O. (Jörgensen, J. pr. (2) **16**. 345.)

—— ***per*iodide,** $I_3Pt(NH_3)_2I, I_2$.
Moderately sl. sol. in H_2O. (Cleve.)

Iodo*di*platinamine iodide, $I_2Pt_2(N_2H_6)_2I_4$.
Insol. in H_2O.

Iodo*di*platin*di*amine anhydroiodide, $I_2Pt_2(N_2H_6)_4OI_2$.
Insol. in NH_4OH + Aq.

—— **anhydronitrate,** $I_2Pt_2(N_2H_6)_4O(NO_3)_2$.
Easily sol. in warm H_2SO_3 + Aq. (Cleve.)

—— **iodide,** $I_2Pt_2(N_2H_6)_4I_4$.
Ppt.

—— **nitrate,** $I_2Pt_2(N_2H_6)_4(NO_3)_4+4H_2O$.
Sl. sol. in cold, moderately sol. in hot H_2O. (Cleve.)

—— **phosphate,** $I_2Pt_2(N_2H_6)_4[O_3P(OH)]_2$.
Nearly insol. in H_2O.

—— **sulphate,** $I_2Pt_2(N_2H_6)_4(SO_4)_2$.
Nearly insol. in H_2O.

—— **plato*di*amine sulphate,** $I_2Pt_2(N_2H_6)_4SO_4, Pt(NH_3)_4SO_4$.
Very sl. sol. in H_2O. (Carlgren, Sv. V. A. F. **47**. 306.)

Iodoplatinic acid, $H_2PtI_6+9H_2O$.
Deliquescent. Easily sol. in H_2O, with decomp. into PtI_4 and HI on standing or warming. (Topsoë.)

Ammonium iodoplatinate, $(NH_4)_2PtI_6$.
Easily sol. in H_2O. (Topsoë.)
NH_4I, PtI_4. Sl. sol. in H_2O; insol. in alcohol. (Lassaigne, A. ch. (2) **51**. 128.)

Barium iodoplatinate, $BaPtI_6$.
Deliquescent, but less so than Na_2PtI_6, which it otherwise resembles. (Lassaigne.)

Calcium iodoplatinate, $CaPtI_6+12H_2O$.
Not so deliquescent as Na salt.

Cobalt iodoplatinate, $CoPtI_6+9H_2O$.
Very deliquescent.

Magnesium iodoplatinate, $MgPtI_6+9H_2O$.
Sol. in H_2O.

Manganese iodoplatinate, $MnPtI_6+9H_2O$.
Very deliquescent.

Nickel iodoplatinate, $NiPtI_6+9H_2O$.
Very deliquescent.

Potassium iodoplatinate, K_2PtI_6.
Easily sol. in H_2O. Insol. in alcohol. Not attacked by cold conc. H_2SO_4.

Sodium iodoplatinate, $Na_2PtI_6+6H_2O$.
Not deliquescent, but easily sol. in H_2O and alcohol. (Vauquelin.) Deliquescent. (Lassaigne.)

Zinc iodoplatinate, $ZnPtI_6+9H_2O$.
Easily sol. in H_2O.

Iodoplatinocyanhydric acid, $H_2Pt(CN)_4I_2$.
See **Periodoplatinocyanhydric acid.**

Strontium iodoplatinocyanide platinocyanide, $SrPt(CN)_4I_2, 10SrPt(CN)_4+xH_2O$.
(Holst.)

Iodopurpureochromium chloride, $ICr(NH_3)_5Cl_2$.
Quite sol. in H_2O. (Jörgensen, J. pr. (2) **25**. 83.)

—— **chloroplatinate,** $ICr(NH_3)_5PtCl_6$.
Precipitate. (Jörgensen, *l.c.*)

—— **iodide,** $ICr(NH_3)_5I_2$.
Difficultly sol. in H_2O. Insol. in HI, or KI + Aq; insol. in alcohol. (Jörgensen, *l.c.*)

—— **nitrate,** $ICr(NH_3)_5(NO_3)_2$.
Much less sol. in H_2O than the chloride. (Jörgensen, *l.c.*)

Iodopurpureocobaltic iodide, $CoI(NH_3)_5I_2$.
(Clandet.)
Does not exist. (Jörgensen, J. pr. (2) **25**. 94.)

Iodopurpureorhodium chloride, $IRh(NH_3)_5Cl_2$.
Relatively easily sol. in H_2O; insol. in HCl + Aq and alcohol. Insol. in KI + Aq. (Jörgensen, J. pr. (2) **27**. 433.)

—— **fluosilicate,** $IRh(NH_3)_5SiF_6$.
Nearly insol. in cold H_2O.

—— **iodoplatinate,** $IRh(NH_3)_5PtI_6$.
Ppt.

—— **iodide,** $IRh(NH_3)_5I_2$.
Very sl. sol. in cold H_2O; more sol. in hot H_2O; insol. in dil. HI + Aq, and alcohol. (Jörgensen, J. pr. (2) **27**. 433.)

Iodopurpureorhodium nitrate, $IRh(NH_3)_5(NO_3)_2$.

Sl. sol. in H_2O, more easily sol. in hot H_2O; insol. in dil. HNO_3 + Aq, and alcohol.

—— **sulphate,** $IRh(NH_3)_5SO_4$, and $+3H_2O$.

Sl. sol. in even hot H_2O. (Jörgensen.)

Iodosulphuric anhydride, ISO_3.

Decomp. very violently by H_2O. (Weber, J. pr. (2) **25.** 224.)

***Di*iodosulphuric anhydride,** I_2SO_3.

Decomp. with H_2O, but not so violently as ISO_3. (Weber, J. pr. (2) **25.** 224.)

Iodo*tri*sulphuric anhydride, $I(SO_3)_3$.

Decomp. by H_2O. (Weber, J. pr. (2) **25.** 224.)

Iodosulphuric acid.

Ammonium iodosulphate, $(NH_4)_2SO_3I_2$ (?).

Very sol. in H_2O. (Zinno, N. Rep. Pharm. **20.** 449.)

Mercuric iodosulphate, $Hg_2(SO_4)I_2$.

See **Mercuric sulphate iodide.**

Potassium iodosulphate, $K_2SO_3I_2$ (?).

Sol. in 7·14 pts. H_2O at 15°. (Zinno, N. Rep. Pharm. **20.** 449.)

Sodium iodosulphate, $Na_2SO_3I_2+10H_2O$.

Sol. in 3·64 pts. H_2O at 15° and in dil. alcohol. (Zinno, N. Rep. Pharm. **20.** 449.)

Does not exist. (Michaelis and Koethe, B. **6.** 999.)

Iodotelluric acid.

Cæsium iodotellurate, Cs_2TeI_4.

Insol. in CsI, or HI + Aq. Decomp. slowly by cold, rapidly by hot H_2O. (Wheeler, Sill. Am. J. **145.** 267.)

Potassium iodotellurate, $K_2TeI_6+2H_2O$.

Sl. efflorescent. Somewhat sol. in KI + Aq, and dil. HI + Aq. (Wheeler.)

Rubidium iodotellurate, Rb_2TeI_6.

Sl. sol. in HI, or RbI + Aq. Decomp. by H_2O. Somewhat sol. in alcohol. (Wheeler.)

Iodotetramine chromium iodide, $ICr(NH_3)_4I_2+H_2O$.

Sol. in H_2O. Pptd. by alcohol. (Cleve.)

Iodotetramine cobaltic sulphate, $ICo(NH_3)_4SO_4$.

(Vortmann and Blasberg, B. **22.** 2652.)

Iodotungstic acid.

See **Tungstoiodic acid.**

Iodous acid, I_2O_3.

See **Iodine *tri*oxide.**

Iodovanadic acid, I_2O_5, $V_2O_5+5H_2O$.

Very easily sol. in H_2O.

$2V_2O_5$, $3I_2O_5+18H_2O$. (Ditte, C. R. **102.** 757.)

Ammonium iodovanadate, $3(NH_4)_2O$, $2V_2O_5$, $5I_2O_5+20H_2O$.

Sol. in H_2O. (Ditte, C. R. **102.** 1019.)

Iridi*di*amine compounds, $Cl_2Ir(NH_3)_4X_2$.

See **Chloriridi*di*amine compounds.**

Iridic acid.

Potassium iridate (?).

Sol. in H_2O and HCl + Aq.

Iridicyanhydric acid, $H_3Ir(CN)_6$.

Easily sol. in H_2O, still more easily in alcohol, less in ether. (Martius, A. **117.** 369.)

Barium iridicyanide, $Ba_3[Ir(CN)_6]_2+18H_2O$.

Efflorescent. Easily sol. in hot or cold H_2O. Nearly insol. in alcohol. Not decomp. by acids.

Potassium iridicyanide, $K_3Ir(CN)_6$.

Easily sol. in H_2O.

Iridium, Ir.

Insol. in all acids, including aqua regia, except when in finely divided state, as "iridium black," when it is sol. in aqua regia. (Claus, J. pr. **42.** 251.)

Iridium ammonia compounds.

See—

Chloriridi*di*amine	**comps.,**	$ClI(NH_3)_2X$.
Irido*tri*amine	,,	$Ir(NH_3)_3X_3$.
Irido*pent*amine	,,	$Ir(NH_3)_5X_3$.
Irido*tetr*amine	,,	$Ir(NH_3)_4X_3$.
Iridoaquo*pent*amine	,,	$Ir(NH_3)_5(OH_2)X_3$.
Iridosoamine	,,	$Ir(NH_3)_2X_2$.
Iridoso*di*amine	,,	$Ir(NH_3)_4X_2$.

Iridium *tri*bromide, $IrBr_3+4H_2O$.

Easily sol. in H_2O. Insol. in alcohol or ether. (Birnbaum.)

Iridium *tetra*bromide, $IrBr_4$, or H_2IrBr_6.

Deliquescent. Sol. in H_2O and alcohol. (Birnbaum.)

See **Bromiridic acid.**

Iridium hydrogen *sesqui*bromide, 3HBr, $IrBr_3+H_2O=H_3IrBr_6+3H_2O$.

See **Bromiridous acid.**

Iridium *sesqui*bromide *with* MBr.

See **Bromiridite, M.**

Iridium *tetra*bromide *with* MBr.

See **Bromiridate, M.**

Iridium phosphorous bromide, $IrBr_3$, $3PBr_3$.

Partially decomp. by H_2O into a sol., and insol. modification. Sol. in PBr_3. (Geisenheimer.)

$IrBr_3$, $2PBr_3$. Not easily attacked by H_2O.

$IrBr_4$, $2PCl_3$.

See **Iridium phosphorous chlorobromide.**

Iridium carbide, IrC_4 (?).

(Berzelius.)

Iridium *tri*chloride, $IrCl_3$.

Insol. in acids or alkalies. (Claus, C. C. **1861.** 690.)

$+4H_2O$. Sol. in H_2O. (Claus.)

Iridium *tetra*chloride, $IrCl_4$, or H_2IrCl_6 (?).
Deliquescent, and easily sol. in H_2O.

Iridium *tri*chloride *with* MCl.
See **Chloriridite, M.**

Iridium *tetra*chloride *with* MCl.
See **Chloriridate, M.**

Iridium chloride *with* potassium chloride *and* sulphite.
See **Chloriridosulphite, potassium.**

Iridium phosphorus chloride, IrP_2Cl_9.
Insol. in cold H_2O. Sl. decomp. by hot H_2O. (Geisenheimer, A. ch. (6) **23.** 254.)

IrP_2Cl_{10}. Very sol. in chloroform. (G.)

IrP_3Cl_{12}. Easily sol. in PCl_3, or $CHCl_3$; also in CS_2 with gradual decomp. Sl. sol. in cold H_2O. Decomp. by boiling into $IrCl_3$, $3H_3PO_4$.

$+H_2O$. Insol. in PCl_3 at 100°. Very slowly sol. in boiling H_2O. (Geisenheimer, A. ch. (6) **23.** 266.)

IrP_3Cl_{15}. Decomp. by H_2O into $2IrCl_3$, $3H_3PO_3$, $3H_3PO_4$. Violently decomp. by alcohol. Sl. sol. in cold, more in hot $POCl_3$, without decomp. Very sol. in PCl_3 with decomp. into IrP_3Cl_{12}; similarly in PBr_3. Sol. in $AsCl_3$ with combination. Sol. in CS_2 with decomp. Sol. in SCl_2 with combination. Easily sol. in cold C_6H_6 with decomp. Insol. in CCl_4. Sol. in $CHCl_3$ with decomp. (Geisenheimer, A. ch. (6) **23.** 254.)

Iridium phosphorus arsenic chloride, $2IrP_3Cl_{15}$, $5AsCl_3$.
Sol. in H_2O with decomp. into corresponding acid. (Geisenheimer, C. R. **110.** 1336.)

$IrCl_3$, $2PCl_3$, $2AsCl_3$. Very sol. in H_2O with decomp. Sol. in $AsCl_3$; insol. in CCl_4. (Geisenheimer.)

Iridium phosphorus sulphur chloride, $IrCl_3$, $2PCl_3$, $2SCl_2$.
Very sol. in sl. amt. H_2O, with decomp. into an acid analogous to chlorophosphoiridic acid. Sol. in SCl_2. (Geisenheimer.)

Iridium phosphorus chlorobromide, $IrBr_4$, $2PCl_3$.
(Geisenheimer, C. R. **111.** 40.)

Iridium *di*hydroxide, IrO_2, $2H_2O=IrO_4H_4$.
Insol. in dil. HNO_3, or H_2SO_4+Aq. Slowly but completely sol. in $HCl+Aq$. Sol. in KOH, and $NaOH+Aq$. (Claus, J. pr. **39.** 104.)

Iridium *sesqui*hydroxide, $Ir_2O_6H_6$.
Not attacked by acids, except slightly by conc. $HCl+Aq$. (Claus, C. C. **1861.** 690.)

Iridium *tri*iodide, IrI_3.
Very sl. sol. in cold, somewhat more in hot H_2O. Insol. in alcohol. (Oppler, J. B. **1857.** 263.)

Iridium *tetra*iodide, IrI_4.
Insol. in H_2O or acids. (Lassaigne.)
Sol. in solutions of iodides. (Oppler.)

Iridium *tri*iodide *with* MI.
See **Iodiridite, M.**

Iridium *tetra*iodide *with* MI.
See **Iodiridate, M.**

Iridium *di*oxide, IrO_2.
Very sl. sol. in acids.
See also **Iridium *di*hydroxide.**

Iridium *sesqui*oxide, Ir_2O_3.
Insol. in acids.

Iridium oxybromide, $Ir_3Br_8O_2=2IrBr_4$, IrO_2.
Not decomp. by H_2O. (Geisenheimer, A. ch. (6) **23.** 286.)

Iridium phosphide, Ir_2P.
(Clarke and Joslin, Am. Ch. J. **5.** 231.)

Iridium *mono*sulphide, IrS.
Insol. in HNO_3+Aq, and very sl. sol. if at all in aqua regia. (Berzelius.)
Sol. in K_2S, and $KSH+Aq$.

$+xH_2O$. Sl. sol. in H_2O; sol. in cold HNO_3+Aq. Insol. in NH_4Cl+Aq or dil. acids. More sol. in K_2S+Aq than PtS_2. (Berzelius.)

Iridium *di*sulphide, IrS_2.
Not attacked by H_2O, but decomp. when exposed moist in air. Not attacked by sat. $HCl+Aq$ or by conc. HNO_3+Aq, but is oxidised by fuming HNO_3+Aq, and aqua regia. Insol. in NH_4 sulphides, or polysulphides + Aq. Slowly sol. in alkali polysulphides + Aq. (Antony, Gazz. ch. it. **23**, **1**. 190.)

Iridium *sesqui*sulphide, Ir_2S_3.
Sl. sol. in H_2O. Sol. in HNO_3, or K_2S+Aq.

Irido*tri*amine chloride, $Ir(NH_3)_3Cl_3$.
Sl. sol. in H_2O. Not attacked by boiling H_2SO_4. (Palmaer, B. **22.** 15.)

Irido*tetr*amine chloride, $Ir(NH_3)_4Cl_3$.
Very sol. in H_2O. (Palmaer, B. **22.** 15.)

—— **chlorosulphate,** $[Ir(NH_3)_4Cl_2]_2SO_4+4H_2O$. (Palmaer.)

Irido*pent*amine bromide, $Ir(NH_3)_5Br_3$.
Sol. in 352 pts. H_2O at 12·5°. (Palmaer, B. **23.** 3817.)

—— **bromochloride,** $Ir(NH_3)_5ClBr_2$.
Sol. in H_2O. (Palmaer, B. **24.** 2090.)

—— **bromonitrite,** $Ir(NH_3)_5Br(NO_2)_2$.
Sol. in 17·9 pts. H_2O at 18°. (Palmaer.)

—— **bromosulphate,** $Ir(NH_3)_5BrSO_4+H_2O$.
Sol. in H_2O. (Palmaer.)

—— **carbonate,** $[Ir(NH_3)_5]_2(CO_3)_3+3H_2O$.
Sol. in H_2O. (Claus, J. pr. **63.** 99.)

—— ***tri*chloride,** $Ir(NH_3)_5Cl_3$.
Sol. in 153·1 pts. H_2O at 15·1°. (Palmaer, B. **23.** 3810.)
Sol. in hot H_2O containing HCl. (Claus, J. pr. **69.** 30.)

—— **chlorobromide,** $Ir(NH_3)_5ClBr_2$.
Sol. in 213·6 pts. H_2O at 15°. (Palmaer.)

—— **chloroiodide,** $Ir(NH_3)_5ClI_2$.
Sol. in 104·5 pts. H_2O at 15°. (Palmaer.)

—— **chlorooxalate,** $Ir(NH_3)_5ClC_2O_4$.
Sl. sol. in H_2O. (Palmaer.)

—— **chloronitrate,** $Ir(NH_3)_5Cl(NO_3)_2$.
Sol. in 51·54 pts. H_2O at 15·4°. (Palmaer.)

Irido*pent*amine chloronitrite, $Ir(NH_3)_5Cl(NO_2)_2$.

Easily sol. in H_2O. (Palmaer.)

—— **chloroplatinate,** $Ir(NH_3)_5Cl_3$, $PtCl_4$.

Very sl. sol. in H_2O. (Palmaer.)

—— **chlorosulphate,** $Ir(NH_3)_5ClSO_4+2H_2O$.

Sol. in 134·5 pts. H_2O at 15°. (Palmaer.)

—— **hydroxide,** $Ir(NH_3)_5(OH)_3$.

Known only in solution, which decomp. on evaporation. (Claus.)

—— **nitrate,** $Ir(NH_3)_5(NO_3)_3$.

Moderately sol. in H_2O. (Claus.)
Sol. in 349 pts. H_2O at 16°. (Palmaer.)

—— **sulphate,** $[Ir(NH_3)_5]_2(SO_4)_3$.

Sol. in H_2O. (Claus.)

Iridoaquo*pent*amine bromide, $Ir(NH_3)_5(OH_2)Br_3$.

Sol. in 4 pts. H_2O. Pptd. from aqueous solution by HBr+Aq. (Palmaer, B. **24.** 2090.)

—— **chloride,** $Ir(NH_3)_5(OH_2)Cl_3$.

Sol. in 1·2 to 1·5 pts. H_2O at ord. temp. Pptd. by HCl+Aq from aqueous solution. (Palmaer, B. **24.** 2090.)

—— **nitrate,** $Ir(NH_3)_5(OH_2)(NO_3)_3$.

Sol. in about 10 pts. H_2O at 17°. Pptd. from aqueous solution by HNO_3+Aq. (Palmaer.)

Iridonitrous acid, $H_6Ir_2(NO_2)_{12}$.

Easily sol. in H_2O. (Gibbs, B. **4.** 281.)

Barium iridonitrite iridochloride, $Ba_3Ir_2(NO_3)_{12}$, $Ba_3Ir_2Cl_{12}$.

Sol. in H_2O. (Lang.)

Mercuric iridonitrite, $Hg_3Ir_2(NO_2)_{12}$.

Insol. in H_2O. (Gibbs, B. **4.** 280.)

Potassium iridonitrite, $K_6Ir_2(NO_2)_{12}+2H_2O$.

Moderately sol. in H_2O.

Potassium iridonitrite iridochloride, $K_6Ir_2(NO_2)_{12}$, $K_6Ir_2Cl_{12}$.

Sol. in H_2O.

Silver iridonitrite, $Ag_6Ir_2(NO_2)_{12}$.

Difficultly sol. in cold, more easily in hot H_2O.

Sodium iridonitrite, $Na_6Ir_2(NO_2)_{12}+2H_2O$.

Sl. sol. in H_2O.

Sodium iridonitrite iridochloride, $Na_4Ir_2Cl_2(NO_2)_8+2H_2O$.

Sl. sol. in H_2O. (Gibbs.)
$Na_6Ir_2(NO_2)_{12}$, $Na_6Ir_2Cl_6$. Insol. in cold, sl. sol. in hot H_2O. (Lang.)

Iridosamine chloride, $Ir(NH_3)_2Cl_2$.

Nearly insol. in H_2O. (Skoblikoff, A. **84.** 275.)

—— **sulphate,** $Ir(NH_3)_2SO_4$.

Easily sol. in H_2O. (Skoblikoff.)

Iridoso*di*amine chloride, $Ir(N_2H_6)_2Cl_2$.

Insol. in cold, decomp. by hot H_2O. (Skoblikoff.)

Iridoso*di*amine nitrate, $Ir(N_2H_6NO_3)_2$.

Easily sol. in H_2O.

—— **sulphate,** $Ir(N_2H_6)_2SO_4$.

Sl. sol. in cold, easily in boiling H_2O. Sl. sol. in alcohol.

Iridosulphuric acid.

Potassium iridosulphate, $K_6Ir_2(SO_4)_6$.

Sol. in H_2O. (de Boisbaudran, C. R. **96.** 1406.)

Iridosulphurous acid.

Ammonium iridosulphite, $(NH_4)_6Ir_2(SO_3)_6+6H_2O$.

Slightly sol. in H_2O. (Birnbaum, A. **136.** 179.)

Potassium iridosulphite, $K_6Ir_2(SO_3)_6+6H_2O$.

Slightly sol. in H_2O.

Sodium iridosulphite, $Na_6Ir_2(SO_3)_6+8H_2O$.

Scarcely sol. in H_2O.

Iron, Fe.

Permanent in dry air; oxidises only slowly in moist air, but rapidly when in contact with air and H_2O simultaneously.

Fe does not rust in contact with air and H_2O containing alkalies even in very small amounts. (Payen, A. ch. **50.** 305.)

Not attacked at ord. temp. by H_2O free from air. More easily oxidised by NH_4 salts+Aq than by H_2O when exposed to air simultaneously. (Persoz, A. ch. (3) **24.** 506.)

100 l. sea water dissolve 27·37 g. from 1 sq. metre Fe; 29·16 g. from 1 sq. metre steel; 1·12 g. from 1 sq. metre galvanised Fe. (Calvert and Johnson, C. N. **11.** 171.)

Iron is slowly attacked by distilled H_2O in presence of air. 100 ccm. distilled water removed 29 mg. from 11·8 sq. cm. iron in one week, while air free from CO_2 was passed through the solution. In presence of CO_2, 54 mg. were removed. (Wagner, Dingl. **221.** 260.)

Iron is most easily oxidised when it is exposed to air, and H_2O is deposited on it at the same time in liquid form. Readily sol. in HCl, dil. H_2SO_4+Aq, and most other acids.

Action of H_2SO_4+Aq (1:12) is very much accelerated by a few drops of $PtCl_4$+Aq; the addition of As_2O_3 arrests the action completely. Tartar emetic and $HgCl_2$ diminish the action, but do not arrest it. $CuSO_4$+Aq strongly accelerates the action, and Ag_2SO_4 + Aq also to a less extent.

In the case of HCl + Aq, the addition of small amts. of metallic salts also influences the action. Weak $HC_2H_3O_2$ + Aq has but little action, and the addition of $PtCl_4$ increases it; As_2O_3 stops it; other solutions have no effect. With racemic and tartaric acids the phenomena are the same.

With oxalic acid $PtCl_4$ prevents the action. Saline solutions and even distilled H_2O, when mixed with $PtCl_4$, have slight solvent action. (Millon, C. R. **21.** 45.)

Above phenomena are due to galvanic action from metal deposited on the iron. (Barreswill, C. R. **21**. 292.)

H_2SO_4 has only sl. action on cast-iron at ord. temp. with exclusion of air.

Weak acids have a strong action at higher temperatures.

Charcoal pig-iron, and case-hardened cast-iron are much less attacked by weak acids at b.-pt. than other sorts of Fe. Scotch pig-iron is most strongly attacked.

99·8 % H_2SO_4 has very sl. action on iron at ord. temp. when air is excluded. (Lunge, Dingl. **261**. 131.)

Resistance against dil. H_2SO_4 + Aq is greatly increased by increase in amt. of C if chemically combined, less so by P or Si. (Ledebur, Dingl. **223**. 326.)

Passive Iron.—When Fe is treated with pure conc. HNO_3 + Aq of 1·512-1·419 sp. gr., it soon becomes coated with a bluish or black coating, apparently FeO, and when thus covered Fe is not attacked by HNO_3 + Aq of any strength at ord. temp. or at the temp. of a freezing mixture; but action occurs on heating. Nor is Fe attacked at ord. temp. by acid of 1·401 sp. gr. or even somewhat weaker acid, though action begins at once on heating. Very dil. HNO_3 + Aq attacks Fe at ord. temp. with formation of NH_4NO_3 and $Fe(NO_3)_2$. The action of HNO_3 + Aq is influenced by $PtCl_4$. If acid containing 4·5 equivalents of H_2O is diluted with 2-3 vols. H_2O, and then poured on Fe turnings, they dissolve at once with evolution of nitrous fumes and formation of ferric salt, but if to the acid one drop of $PtCl_4$ be added, only H gas is evolved, and NH_4NO_3 and $Fe(NO_3)_2$ are formed. (Millon, C. R. **21**. 47.)

The more H_2O the acid contains the lower will be the temp. at which the Fe remains passive. Shaking the wire hastens the passivity. Contact with Pt, Au, or C does not prevent it. Fe wire becomes passive by remaining 10 min. in HNO_3 vapour. (Renard, C. R. **79**. 159.)

Iron may be made passive by $HClO_3$, $HBrO_3$, HIO_3, H_2CrO_4, in the same way as by HNO_3.

Iron may also be made passive by moderate ignition.

Passivity occurs with HNO_3 + Aq of 1·38 sp. gr. after a short time at 31°; but if temp. is 32°, passivity does not occur.

Colourless HNO_3 + Aq of 1·42 sp. gr. produces passivity at 55° but not at 56°. Red fuming HNO_3 + Aq of 1·42 sp. gr. produces passivity at 82° but not at 83°. (Ordway, Sill. Am. J. (2). **40**. 316.)

The passivity of Fe is destroyed when it is placed in a magnetic field at a much lower temperature than when in normal condition. (Nichols and Franklin, Sill. Am. J. (3) **34**. 419.)

Passivity depends on a coating of NO which hinders the action of the acid. All operations which remove this layer terminate the passivity, as shaking, rubbing, placing in a vacuum, etc. (Varenne, C. R. **89**. 783.)

When Fe is plunged in HNO_3 + Aq of 1·42 sp. gr. there is a sudden evolution of gas which ceases after 3 to 20 seconds, and the surface becomes bright. The same phenomena take place with a more dilute acid, if of not less than 1·32 sp. gr. In the latter case, there is an immediate evolution of gas, which suddenly ceases and the metal becomes bright, but soon the acid begins to act again at a single point, and the action gradually spreads over the whole surface; this, however, soon ceases again, and we have an "intermittent passivity."

If a part of a piece of iron is immersed in strong acid, the whole of it is made passive. This is explained by the NO spreading over the whole surface by capillarity.

The passivity ceases when the Fe is placed in dil. acid, after a longer or shorter time, according to the dilution of the acid,—
when the acid has sp. gr. = 1·30, after 11 days
,, ,, ,, 1·28 ,, 5 ,,
,, ,, ,, 1·26 ,, 32 hours
,, ,, ,, 1·16 ,, 12 ,,

Iron may also be made passive by long standing in NO gas under pressure. (Varenne, C. R. **90**. 998.)

Fe is made passive by a coating of Fe_3O_4, not by NO. (Schönbein, Pogg. **39**. 342.) (Beetz, Pogg. **67**. 286.) (Ramann, B. **14**. 1430.)

Passivity may also be caused by NH_4NO_3 + Aq, ammoniacal $AgNO_3$ + Aq, $Fe(NO_3)_3$, $Fe(NO_3)_2$, $Al(NO_3)_3$, $Co(NO_3)_2$, $Ni(NO_3)_2$, etc. + Aq instead of HNO_3 + Aq. (Ramann, B. **14**. 1933.)

Hardly attacked by either dil. or conc. acids when they are under high pressure. (Cailletet, C. R. **68**. 395.)

Iron is dissolved by HNO_3 + Aq, even when very conc., but no gas is evolved and the process is very slow.

HNO_3 + Aq of the following sp. gr. dissolves the following amts. from strips of pure Fe.

Sp. gr. of acid	Diminution of weight in 24 hours
1·28	0·82 %
1·34	0·75
1·38	0·29
1·48	0·34
1·53	5·80

(Gautier and Charpy, C. R. **113**. 1451.)

Not attacked by alkalies.

Sol. in NaOH + Aq (34 %) when air is blown through the liquid. (Zirnité, Ch. Ztg. **12**. 355.)

NaOH + Aq attacks iron and steel. (Venator, Dingl. **261**. 133.)

NaOH + Aq has slight action on Fe between 15° and 100°. (Lunge, Dingl. **261**. 131.)

Presence of alkalies prevent rusting entirely, and fats and oils greatly hinder it. (Wagner.)

Sol. in alkali hydrogen carbonates + Aq. (Berzelius.)

Sat. NaCl + Aq has sl. but perceptible action on Fe. NH_4Cl + Aq has stronger action than NaCl + Aq. (Lunge.)

100 ccm. H_2O containing 0·5 g. NaCl or

KCl removed 42 mg. from 11·8 sq. cm. iron in one week, while air free from CO_2 was passed through the solution, and 72 mg. in presence of CO_2.

100 ccm. H_2O containing 1 g. NH_4Cl removed 45 mg., and 76 mg. respectively under the above conditions.

100 ccm. H_2O containing 0·8 g. $MgCl_2$ removed 49 mg., and 65 mg. respectively under the above conditions.

Not attacked by 100 ccm. H_2O containing 1 g. Na_2CO_3, or by CaO_2H_2+Aq. (Wagner, Dingl. **221**. 260.)

Action of $KClO_3$+Aq. $KClO_3$+Aq (6·3 % $KClO_3$) oxidised 11·21 g. cast iron and 20·1 g. pure iron from a surface of 1 sq. metre in 7 hours; $KClO_3$+Aq (25 % $KClO_3$) oxidised 24·59 g. cast, and 44·90 g. pure Fe under above conditions; $Ca(ClO_3)_2$, $CaCl_2$+Aq (20° Baumé) obtained by passing Cl through CaO_2H_2+Aq oxidised 85·00 g. cast, and 95 g. pure Fe under the above conditions. (Lunge and Deggeler, J. Soc. Chem. Ind. **4**. 32.)

Easily sol. in organic acids.

Comparative action of oils on Fe.

	Amount Fe dissolved
Neatsfoot oil	0·0875 grains
Colza ,,	0·0800 ,,
Sperm ,,	0·0460 ,,
Lard ,,	0·0250 ,,
Olive ,,	0·0062 ,,
Linseed ,,	0·0050 ,,
Seal ,,	0·0050 ,,
Castor ,,	0·0048 ,,
Paraffine ,,	0·0045 ,,
Almond ,,	0·0040 ,,
"Lubricating" oil	0·0018 ,,

(Watson, C. N. **42**. 190.)

Fe dissolves in albumen solution to the extent of 1 to 2 per cent. (Buchner, Arch. Pharm. (3) **20**. 417.)

Attacked by sugar+Aq at 115-120°, also by inverted sugar or malt extract, not by glycerine or mannite+Aq. (Klein and Berg, C. R. **102**. 1170.)

Iron arsenide, $FeAs_2$.

Min. *Löllingite*. Sol. in HNO_3+Aq with separation of As_2O_3.

Fe_3As_4. Min. *Leucopyrite*.

Iron arsenide sulphide, $FeAs_2$, FeS_2.

Min. *Arsenopyrite*. Sol. in HNO_3+Aq with separation of S and As_2O_3; wholly sol. in aqua regia; not attacked by HCl+Aq.

Iron boride.

Decomp. by H_2O. (Fremy.)

Ferrous bromide, $FeBr_2$.

Sol. in H_2O. Decomp. by heating on air.

$+6H_2O$. Sol. in H_2O. (Löwig.)

Ferric bromide, $FeBr_3$.

Deliquescent. Sol. in H_2O, alcohol, and ether. (Löwig.)

Ferrous mercuric bromide.

Deliquescent. (v. Bonsdorff.)

Ferrous stannic bromide.

See **Bromostannate, ferrous.**

Ferric bromochloride, $FeCl_2Br$.

Very deliquescent, and sol. in H_2O, alcohol, and ether. Notably sol. in chloroform, benzene, and toluene. Insol. in CS_2. (Lenormand, C. R. **116**. 820.)

Iron carbide, Fe_8C.

(Gurlt, J. B. **1856**, 781.)

Mixture of Fe and FeC_4. (Tunner, Polyt. Centralbl. **1861**. 1227.)

Fe_4C. (Karsten, J. pr. **40**. 229.)

Fe_2C_2. (Rammelsberg, C. C. **1847**. 60.)

Fe_2C_3, FeC_3, etc., are probably mixtures.

Iron carbonyl, $Fe(CO)_5$.

Slowly decomp. on air. Not attacked by dil. H_2SO_4, HNO_3, or HCl+Aq. Conc. HNO_3, Cl_2+Aq, or Br_2+Aq decomp. easily. Sol. in alcoholic solution of KOH or NaOH with subsequent decomp. Sol. in alcohol, ether, benzene, mineral oils, etc. (Mond and Langer, Chem. Soc. **59**. 1090.)

$Fe_2(CO)_7$. Decomp. on air. Not attacked by H_2SO_4 or HCl+Aq. Sol. in alcoholic potash. Very much less sol. in organic solvents than $Fe(CO)_5$. (Mond and Langer.)

Ferrous chloride, $FeCl_2$.

Deliquescent. Easily sol. in H_2O with evolution of heat, or in alcohol. Insol. in ether. (Jahn.)

Sol. in 2 pts. H_2O at 18·75°. (Abl.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

$+2H_2O$. (Jonas.)

$+4H_2O$. Deliquescent. Easily sol. in alcohol. Sol. in 0·68 pt. cold H_2O. (Reimann, Mag. Pharm. **17**. 215.)

More sol. in water containing NO than in pure H_2O. (Gay, Bull. Soc. (2) **44**. 175.)

Ferroferric chloride, $Fe_3Cl_8+18H_2O$.

Deliquescent. (Lefort, J. Pharm. (4) **10**. 85.)

Ferric chloride, Fe_2Cl_6 or $FeCl_3$.

Very deliquescent, and sol. in H_2O with evolution of great heat.

100 mols. H_2O dissolve mols. anhydrous Fe_2Cl_6 at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
66	29·20	80	29·20
70	29·42	100	29·75
75	28·92	...	...

(Roozeboom, Z. phys. Ch. **10**. 477.)

Solution in H_2O is decomp. into colloidal Fe_2O_3, xH_2O and HCl, upon heating if conc., and on simple standing if dil.

Krecke (J. pr. (2) **3.** 286) gives the following table.

% Fe_2Cl_6 in solution	Temp. at which Graham's colloidal hydrate is formed		Temp. at which Saint Gilles' colloidal hydrate is formed	Temp. at which oxychlorides are formed	Temp. at which Fe_2O_3 is formed
32	100-130°	Fe_2Cl_6 re-formed on cooling.	...	100°+	140°
16	100-120		...	,,	120
8	100-110		...	,,	110
4	90-100		...	90	...
2	87		...	87	...
1	83	Fe_2Cl_6 not reformed on cooling.	100-130°	...	...
0·5	75		,,	...	...
0·25	64		,,	...	...
0·125	54		,,	...	...
0·0625	36		,,	...	...

Sol. in conc. NH_4Cl+Aq (Claus); sat. KCl+Aq (Gibbs).

Sol. in alcohol ether, acetic ether (Cann, C. R. **102.** 363), and acetone (Krug and M'Elroy, J. anal. Ch. **6.** 184).

Sp. gr. of Fe_2Cl_6+Aq at 17·5°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.
1	1·0073	21	1·1644	41	1·3746
2	1·0146	22	1·1746	42	1·3870
3	1·0219	23	1·1848	43	1·3994
4	1·0292	24	1·1950	44	1·4118
5	1·0365	25	1·2052	45	1·4242
6	1·0439	26	1·2155	46	1·4367
7	1·0513	27	1·2258	47	1·4492
8	1·0587	28	1·2365	48	1·4617
9	1·0661	29	1·2464	49	1·4742
10	1·0734	30	1·2568	50	1·4867
11	1·0814	31	1·2673	51	1·5010
12	1·0894	32	1·2778	52	1·5153
13	1·0974	33	1·2883	53	1·5296
14	1·1054	34	1·2988	54	1·5439
15	1·1134	35	1·3093	55	1·5582
16	1·1215	36	1·3199	56	1·5729
17	1·1297	37	1·3305	57	1·5876
18	1·1378	38	1·3411	58	1·6023
19	1·1458	39	1·3517	59	1·6170
20	1·1542	40	1·3622	60	1·6317

(Franz, J. pr. (2) **5.** 283.)

Sp. gr. of Fe_2Cl_6+Aq.

% Fe_2Cl_6	Sp. gr. at 4·8°	Sp. gr. at 9·7°	Sp. gr. at 14·6°	Sp. gr. at 19·7°
49·61	1·5609	1·5575	1·5540	1·5497
41·00	1·4413	1·4387	1·4361	1·4335
36·95	...	1·3847	1·3824	1·3800
33·25	1·3381	1·3359	1·3339	1·3317
24·60	1·2351	1·2334	1·2318	1·2298
22·54	1·2140	1·2129	1·2107	1·2090
16·79	1·1534	1·1521	1·1507	1·1491
10·45	1·0939	1·0930	1·0918	1·0901
4·65	...	...	1·0382	...
2·70	...	...	1·0221	...

(Schult, from Gerlach, Z. anal. **27.** 278.)

Sp. gr. of Fe_2Cl_6+Aq at 17·5°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.
1	1·008	21	1·191	41	1·428
2	1·016	22	1·202	42	1·441
3	1·025	23	1·212	43	1·454
4	1·033	24	1·223	44	1·469
5	1·042	25	1·234	45	1·481
6	1·051	26	1·245	46	1·494
7	1·060	27	1·256	47	1·507
8	1·069	28	1·268	48	1·520
9	1·078	29	1·280	49	1·533
10	1·087	30	1·292	50	1·547
11	1·095	31	1·304	51	1·560
12	1·104	32	1·316	52	1·573
13	1·113	33	1·328	53	1·587
14	1·123	34	1·340	54	1·600
15	1·131	35	1·352	55	1·612
16	1·140	36	1·364	56	1·624
17	1·150	37	1·376	57	1·636
18	1·160	38	1·390	58	1·648
19	1·170	39	1·403	59	1·659
20	1·180	40	1·415	60	1·670

(Hager, Comm. **1883.**)

Sp. gr. of Fe_2Cl_6+Aq increases or diminishes between 8° and 24° for a decrease or increase of temp. of 1° by the following amts.

% Fe_2Cl_6	Corr.	% Fe_2Cl_6	Corr.
50-60	0·0008	30-39	0·0005
45-49	0·0007	20-29	0·0004
40-44	0·0006	10-19	0·0003

(Hager, *l.c.*)

Sp. gr. of conc. Fe_2Cl_6+Aq at 20-21°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.
60	1·669	65	1·715	70	1·758
61	1·679	66	1·724	71	1·766
62	1·688	67	1·733	72	1·774
63	1·697	68	1·742	73	1·782
64	1·706	69	1·750	74	1·790

(Hager, *l.c.*)

The salts with different amts. of crystal H_2O have different solubilities. (Roozeboom.)

$+4H_2O$. Melts in crystal H_2O at 73·5°.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+4H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
50	19·96	69	21·53	72·5	26·15
55	20·32	72·5	23·35	70	27·90
60	20·70	73·5	25·00	66	29·20

(Roozeboom, Z. phys. Ch. **10.** 477.)

$+5H_2O$. Correct formula for $+6H_2O$ salt.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+5H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
12	12·87	30	15·12	55	19·15
20	13·95	35	15·64	56	20·00
27	14·85	50	17·50	55	20·32

(Roozeboom.)

Melts in crystal H_2O at 31° (Engel, C. R. **104.** 1708); at 56° (Roozeboom).

$+6H_2O$. Very deliquescent. Sol. in alcohol. Ether dissolves out Fe_2Cl_6

M.-pt. is 31°. (Ordway.) Contains only $5H_2O$. (Roozeboom.)

$+7H_2O$. Melts in crystal H_2O at 32·5°.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+7H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
20	11·35	32	13·55	30	15·12
27·4	12·15	32·5	14·99	25	15·54

(Roozeboom.)

$+12H_2O$. Less deliquescent than Fe_2Cl_6 or $Fe_2Cl_6+5H_2O$.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+12H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
−55	2·75	30	5·93	27·4	11·20
−41	2·81	35	6·78	20	12·15
−27	2·98	36·5	7·93	10	12·83
0	4·13	37	8·33	8	13·70
10	4·54	36	9·29	...	...
20	5·10	30	10·45	...	...

(Roozeboom.)

Sol. in alcohol. Ether dissolves out Fe_2Cl_6.

Melts in crystal H_2O at 37° (Roozeboom); at 35·5° (Ordway).

Ferric hydrogen chloride, $FeCl_3$, $HCl+2H_2O$.

Decomp. by H_2O. (Sabatier, Bull. Soc. (2) **197.**)

More sol. in H_2O than $FeCl_3$. (Engel, C. R. **104.** 1708.)

Ferrous lithium chloride, $FeCl_2$, $LiCl+3H_2O$. (Chassevant, A. ch. (6) **30.** 17.)

Ferric magnesium chloride, $FeCl_3$, $MgCl_2+H_2O$.

Deliquescent. (Neumann, B. **18.** 2890.)

Ferrous mercuric chloride, $FeCl_2$, $HgCl_2+4H_2O$.

Deliquescent. (v. Bonsdorff.)

Ferric nitrosyl chloride, $FeCl_3$, NOCl.

Very deliquescent. (Weber, Pogg. **118.** 477.)

Ferric phosphoric chloride, $FeCl_3$, PCl_5.

Decomp. by H_2O. (Baudrimont, A. ch. (4) **2.** 15.)

Ferrous potassium chloride, $FeCl_2$, $2KCl+2H_2O$.

Sol. in H_2O. (Berzelius.)

Ferric potassium chloride, $FeCl_3$, $2KCl+H_2O$.

A little H_2O dissolves out $FeCl_3$. (Fritzsche, J. pr. **18.** 483.)

Ferric rubidium chloride, $FeCl_3$, 3RbCl.

Easily sol. in H_2O. Insol. in HCl+Aq. (Godeffroy, Arch. Pharm. (3) **9.** 343.)

$FeCl_3$, $2RbCl+H_2O$. Decomp. by H_2O. (Neumann, A. **244.** 329.)

Ferric thallium chloride, $FeCl_3$, 3TlCl.

Decomp. by H_2O. Can be crystallised from HCl+Aq. (Wöhler, A. **144.** 250.)

Ferrous chloride ammonia, $3FeCl_2$, $2NH_3$.

Decomp. by H_2O. (Rogstadius, J. pr. **86.** 310.)

$FeCl_2$, $6NH_3$. (Rogstadius.)

Ferric chloride ammonia, $FeCl_3$, NH_3.

Slowly deliquescent. Sol. in H_2O with evolution of heat. (Rose, Pogg. **24.** 302.)

Ferric chloride cyanhydric acid, $FeCl_3$, 2HCN.

Deliquescent. (Klein, A. **74.** 85.)

Ferrous chloride nitric oxide, $FeCl_2$, NO.

Known only in solution.

Ferrous fluoride, FeF_2.

Sl. sol. in H_2O; insol. in alcohol and ether. Partly sol. in hot HCl+Aq; slowly sol. in cold, easily in hot HNO_3; decomp. by H_2SO_4. (Poulenc, C. R. **115.** 941.)

$+8H_2O$. Difficultly sol. in H_2O; more easily if it contains HF. (Berzelius.)

Ferric fluoride, FeF_3.

Sl. sol. in H_2O; insol. in alcohol or ether. Sl. attacked by HNO_3, HCl, or H_2SO_4+Aq. (Poulenc, C. R. **115.** 941.)

$+4\frac{1}{2}H_2O$. More sol. in hot than cold H_2O. Insol. in alcohol. (Scheurer-Kestner, A. ch. (3) **68.** 472.)

Ferrous potassium fluoride, FeF_2, $KF+2H_2O$. (Wagner, B. **19.** 896.)

FeF_2, $2KF$. Sl. sol. in H_2O. (Berzelius.)

Ferric potassium fluoride, FeF_3, $2KF$.

Somewhat sol. in H_2O, especially if hot. (Berzelius.)

$+H_2O$. (Christensen, J. pr. (2) **35.** 164.)

FeF_3, $3KF$. Properties as above. (Berzelius.)

Ferric sodium fluoride, FeF_3, $2NaF+\frac{1}{2}H_2O$.

Rather easily sol. in H_2O. Solution decomp. on heating. Very sol. in $FeCl_3+Aq$. (Nicklès, J. Pharm. (4) **10.** 14.)

FeF_3, $3NaF$. (Wagner, B. **19.** 896.)

Ferrous titanium fluoride.

See **Fluotitanate, ferrous.**

Ferrous hydroxide, FeO_2H_2.

Sol. in 150,000 pts. H_2O. (Bineau, C. R. **41.** 509.)

Insol. in KOH, or $NaOH+Aq$. Sol. in NH_4 salts$+Aq$. Sl. sol. in $NaC_2H_3O_2+Aq$. (Mercer.)

Not pptd. in presence of Na citrate. Insol. in boiling cane sugar$+Aq$, but sl. sol. when KOH has been added. Not pptd. in presence of much $H_2C_4H_4O_6$. (Rose.)

Ferric hydroxides, Fe_2O_3, xH_2O.

Many indefinite compounds of Fe_2O_3 and H_2O are known, and uncertainty exists as to their composition.

According to van Bemmelen (R. t. c. **7.** 106), there are probably no true definite compounds of Fe_2O_3 and H_2O.

According to Tommasi (B. **12.** 1924, 2334), there are two series of Fe hydroxides, α or red hydroxides, and β or yellow hydroxides.

α *Hydroxides.* $Fe_2O_6H_6$ (unstable), Fe_2O_3, $2H_2O$ (loses H_2O at 50°), and Fe_2O_3, H_2O (loses H_2O at 92°).

Sol. in dil. acids and in Fe_2Cl_6+Aq, and pptd. from the latter solution by Na_2SO_4, or H_2SO_4+Aq.

β *Hydroxides.* $Fe_2O_6H_6$ (stable below 70°), Fe_2O_3, $2H_2O$ (loses H_2O at 105°), Fe_2O_3, H_2O (loses H_2O at 150°).

Sl. sol. in acids, and insol. in Fe_2Cl_6+Aq. (Tommasi.)

The following more or less uncertain data are given.

$2Fe_2O_3$, H_2O. Sol. in $HCl+Aq$. Very sl. sol. in HNO_3+Aq. (Davies, Chem. Soc. (2) **4.** 69.)

Min. *Turgite.*

Fe_2O_3, H_2O. Insol. in cold acids, difficultly sol. in warm HCl and H_2SO_4+Aq, and especially in warm HNO_3+Aq. (Schiff, A. **114.** 199.)

Min. *Göthite.*

$2Fe_2O_3$, $3H_2O$. Sl. sol. in tartaric, citric, or acetic acids, but easily sol. in $HCl+Aq$. (Wittstein.)

Scarcely attacked by conc. HNO_3, or $HCl+Aq$. Sol. in acetic acid or dil. HNO_3, or $HCl+Aq$, from which solution it is pptd. by trace of alkali salts. (St. Gilles.)

Min. *Limonite.*

$3Fe_2O_3$, $5H_2O$. (Muck.)

Fe_2O_3, $2H_2O$. Easily sol. in $HCl+Aq$.

Min. *Xanthosiderite.*

Fe_2O_3, $3H_2O$. Sl. sol. in acetic acid of 1·03 sp. gr., but easily sol. if of 1·076 sp. gr. Sol. in mineral acids. (Limberger, J. B. **1853.** 70.)

Pptd. Fe_2O_3, $xH_2O=Fe_2O_6H_6$ (?). Insol. in H_2O, or in solutions of the alkalies or NH_4 salts. When recently pptd. is easily sol. in acids. (Fresenius.)

Sl. sol. in NH_4OH, and NH_4 salts $+Aq$. (Odling.)

Apparently insol. in NH_4Cl, or $(NH_4)_2CO_3+Aq$. (Brett, **1837.**)

Sl. sol. in conc., but insol. in dil. $KOH+Aq$. (Chodnew, J. pr. **28.** 221.)

Sl. sol. in very conc. $KOH+Aq$ free from CO_2. (Völcker, A. **59.** 34.)

Not at all sol. in pure conc. $KOH+Aq$, solubility noticed by previous observers being caused by the presence of silicic acid. (Sandrock.)

Sl. sol. in conc. alkali carbonates $+Aq$.

When freshly pptd., it is not acted upon by conc. K_2CO_3+Aq. (Grotthaus.)

Readily sol. in conc. $(NH_4)_2CO_3+Aq$, but pptd. by addition of H_2O.

Sol. in excess of $(NH_4)_2CO_3+Aq$ when pptd. by that reagent. (Wöhler.)

Sol. in solutions of the alkali bicarbonates. (Berzelius.)

Sol. in aqueous solutions of water-glass. (Ordway.)

Insol. in fumaric acid, even when freshly pptd.

When recently pptd., it is easily sol. in $KHC_4H_4O_6+Aq$, but after drying it is difficultly sol. therein.

When moist easily sol. in $H_2C_4H_4O_6+Aq$, but after drying is scarcely sol. therein when cold, and only sl. sol. when hot. (Werther.)

Easily sol. in acetic, citric, and other acids. (Wittstein.)

Immediately dissolved by H_2SO_3+Aq.

Sol. in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 124.)

Sol. in conc. $Al_2(SO_4)_3+Aq$. (Schneider, B. **23.** 1352.)

Sl. sol. in a solution of $MgCO_3$ (?). (Bischof.)

Insol. in ethylamine, or amylamine $+Aq$. (Wurtz, A. ch. (3) **30.** 472.)

Sol. in boiling solution of $Bi(NO_3)_3$, with pptn. of Bi_2O_3. (Persoz.)

Easily sol. in aqueous solution of sucrates of Ca, Ba, Sr, K, Na. (Hunton, **1837.**)

Unacted upon by cane sugar $+Aq$. (Gladstone.)

Sl. sol. in cane sugar $+Aq$, from which it is pptd. by $(NH_4)_2S+Aq$, but not by NH_4OH, or $K_4FeC_6N_6+Aq$. (Peschier.)

Not pptd. from solutions by alkalies or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc.

Not pptd. by NH_4OH from solutions containing $Na_4P_2O_7$. (Rose, Pogg. **76.** 19.)

Not pptd. by NH_4OH in presence of Na citrate. (Spiller.)

Sol. in Cr_2Cl_6+Aq; after 3 months 15 mols.

$Fe_2O_6H_6$ were dissolved by 1 mol. Cr_2Cl_6. (Béchamp, A. ch. (3) **57.** 296.)

Soluble. (*a*) *By dialysis.* Solutions containing 1 % can be concentrated somewhat, whereupon they gelatinise. They also gelatinise by cold, or addition of traces of H_2SO_4, alkalies, alkali carbonates or sulphates, or neutral salts, not, however, by HCl, HNO_3, alcohol, or sugar. (Graham, A. **121.** 46.)

When a dil. solution of a solid organic acid, or an alkali, or salt is added to a dialysed solution of $Fe_2O_6H_6$, a coagulum sol. in H_2O is formed, but if the solutions are conc. the separating coagulum is no longer sol. in H_2O. (Athenstädt, C. C. **1871.** 822.)

(*b*) *Pean St. Gilles' hydroxide*, or *meta-iron hydroxide.* Sol. in H_2O. Pptd. from solution by traces of H_2SO_4, HCl, HNO_3 + Aq, and alkalies; the ppt. is insol. in cold acids, but sol. in pure H_2O. (Pean St. Gilles, A. ch. (3) **46.** 47.)

See also table by Krecke in the article on ferric chloride.

Ferroferric hydroxide, Fe_3O_4, H_2O (?).

Sol. in acids.

Fe_3O_4, $4H_2O$. (Lefort.)

Ferrous iodide, FeI_2.

Very deliquescent. Sol. in H_2O. Solution decomp. on evaporating.

$+5H_2O$. Deliquescent. Sol. in alcohol. Sol. in sugar + Aq, and solution is much more stable than aqueous solution. Easily sol. in glycerine.

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Ferric iodide, FeI_3.

Has not been isolated. Solution of I in FeI_2 + Aq in the molecular ratio of I : FeI_2 probably contains FeI_3.

Ferrous mercuric iodide.

Very deliquescent. Decomp. by H_2O; sol. in $HC_2H_3O_2$ or alcohol.

Iron molybdenide, $FeMo_2$.

Attacked by HCl + Aq with difficulty. Sol. in hot conc. H_2SO_4. (Steinacker.)

Iron nitride, Fe_2N.

Easily sol. in HNO_3, HCl, or H_2SO_4 + Aq. Very slowly decomp. by H_2O. (Stahlschmidt, Pogg. **125.** 37.)

Fe_5N_2. Probably the same as the above compound. (Rogstadius, J. pr. **86.** 307.)

Iron nitrososulphantimonate, $Fe_4S(NO)_6Sb_2S_5$.

(Löw, C. C. **1865.** 948.)

Does not exist, but was impure sodium ferro*tetra*nitrososulphide. (Pawel, B. **15.** 2600.)

Iron nitrososulphides.

See **Ferro*tetra*nitrososulphydric acid** *and* **Ferro*hepta*nitrososulphide, ammonium.**

$Fe_3S_5H_2(NO)_4$. (Roussin, C. R. **46.** 224.)

$Fe_3S_3(NO)_4 + 2H_2O$. (Porczinsky, A. **125.** 302.)

$Fe_6S_5(NO)_{10} + 4H_2O$. (Rosenberg, B. **3.** 312.)

The compound to which the above formulæ were given was impure, according to Pawel (B. **12.** 1407 and 1949; **15.** 2600), and contained more or less Na or NH_4. Pawel considers the substance as NH_4 salt of ferro*hepta*nitrososulphydric acid, which see.

Iron sodium nitrososulphide, $3Na_2S, Fe_2S_3, 2NO$.

(Roussin.)

$Na_8Fe_8S_9(NO)_{18}$. (Rosenberg.)

Correct formula is $Na_2S_2(NO)_4Fe_2$, sodium ferro*tetra*nitrososulphide.

Iron nitrososulphocarbonate, $Fe_4S(NO)_6CS_2 + 3H_2O$. (Löw, C. C. **1865.** 948.)

Correct formula is $NaS_3(NO)_7Fe_4 + 2H_2O$, sodium ferro*hepta*nitrososulphide. (Pawel, B. **15.** 2600.)

Ferrous oxide, FeO.

Insol. in H_2O. Sol. in acids.

Easily sol. in HCl, and HNO_3 + Aq; nearly insol. in H_2SO_4, even when heated. (Tissandier, C. R. **74.** 531.)

Ferric oxide, Fe_2O_3.

Attacked by acids with difficulty, the more so the higher it has been heated. HCl + Aq is the best solvent, in which it is more quickly sol. by long digestion at a gentle heat than by boiling. (Fresenius.)

Most easily sol. in 16 pts. of a mixture of 8 pts. H_2SO_4 and 3 pts. H_2O. (Mitscherlich, J. pr. **81.** 110.)

Absolutely insol. in Br_2 + Aq. (Balard.)

Insol. in hot NH_4Cl + Aq. (Rose.)

Insol. in KOH + Aq. (Chodnew, J. pr. **28.** 222.)

Solubility in (calcium sucrate + sugar) + Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 6·26 g. Fe_2O_3; 296·5 g. sugar and 24·2 g. CaO dissolves 4·71 g. Fe_2O_3; 174·4 g. sugar and 14·1 g. CaO dissolves 3·08 g. Fe_2O_3. (Bodenbender, J. B. **1865.** 600.)

See also **Ferric hydroxide.**

Min. *Hematite.* Rather easily sol. in HCl + Aq, but not readily sol. in other acids.

***Meta*iron oxide.**

See **Ferric hydroxides.**

Ferroferric oxide, $6FeO, Fe_2O_3$.

FeO, $Fe_2O_3 = Fe_3O_4$. With insufficient HCl + Aq for complete solution, FeO is dissolved and Fe_2O_3 left. (Berzelius.)

Insol. in HNO_3 + Aq at the ordinary temperature. (Millon.)

Min. *Magnetite.* Insol. in HNO_3, but sol. in hot HCl + Aq.

Iron *sesqui*oxide zinc oxide, Fe_2O_3, ZnO.

See **Ferrite, zinc.**

Ferric oxybromide.

Basic ferric bromides containing three equivalents, or less, of base to one of acid may be obtained dissolved in H_2O. (Ordway, Am. J. Sci. (2) **26.** 202.)

The most basic soluble compound obtained by three months' digestion of $Fe_2O_6H_6$ with Fe_2Br_6 + Aq, is Fe_2Br_6, $14Fe_2O_3$. (Béchamp.)

Ferric oxychlorides.

(*a*) *Soluble.* $Fe_2O_6H_6$ dissolves in Fe_2Cl_6 +

Aq. By digesting until the acid reaction of the chloride has disappeared a solution of Fe_2Cl_6, $2Fe_2O_3$ is obtained. (Pettenkofer, Repert. (2) **41**. 289.)

By digesting for several days in the cold, Fe_2Cl_6, $5Fe_2O_3$ is obtained, and still more basic compounds by further addition of $Fe_2O_6H_6$. When the solution contains Fe_2Cl_6, $12Fe_2O_3$ it gelatinises, but still dissolves completely in H_2O. The most basic soluble compound is Fe_2Cl_6, $20Fe_2O_3$. (Béchamp, A. ch. (3) **57**. 296.)

If the digestion is carried on several weeks, a solution containing Fe_2Cl_6, $23Fe_2O_3$ is obtained; this can be boiled and diluted without pptn., but $Fe_2O_6H_6$ is precipitated by the addition of very many salts. (Ordway, Sill. Am. J. (2) **26**. 197.)

Solutions containing 10 or less molecules Fe_2O_3 to 1 mol. Fe_2Cl_6 can be dried without the oxychloride becoming insoluble. (Ordway.)

The above solutions do not become cloudy by boiling or diluting. (Phillips.)

A very dil. solution of Fe_2Cl_6, $10Fe_2O_3$ remains clear after protracted boiling, and may be boiled without decomp. even when Fe_2Cl_6, $20Fe_2O_3$ is present. (Béchamp.)

HNO_3, and $HCl+Aq$ form precipitates in the above solutions, which are sol. on addition of more H_2O. H_2SO_4+Aq forms a precipitate insol. in H_2O. (Béchamp.)

Fe_2Cl_6, $9Fe_2O_3$ is easily sol. in H_2O, weak alcohol, and glycerine; but solutions are pptd. by small amts. of H_2SO_4, M_2SO_4, citric or tartaric acids, or a few drops of HCl, or HNO_3+Aq. (Jeannel, C. R. **46**. 799.)

Solutions containing 5 mols. Fe_2O_3 to 1 mol. Fe_2Cl_6 are completely precipitated by K_2SO_4, Na_2SO_4, $MgSO_4$, KNO_3, $NaNO_3$, $Zn(NO_3)_2$, KCl, NaCl, NH_4Cl, $CaCl_2$, $MgCl_2$, $ZnCl_2$, KBr, or KSCN. (Béchamp.)

$Ba(NO_3)_2$ does not precipitate solutions of less than 18-20 Fe_2O_3 to 1 Fe_2Cl_6.

$Pb(NO_3)_2$ or $Pb(C_2H_3O_2)_2$ do not precipitate solutions containing the compound Fe_2Cl_6, $12Fe_2O_3$, but a mixture of the two salts causes complete precipitation.

Solution has been obtained containing 116 Fe_2O_3 to 1 Fe_2Cl_6, probably owing to a formation of soluble colloidal Fe_2O_3. (Magnier de la Source, C. R. **90**. 1352.)

(β) *Insoluble*. Fe_2Cl_6, $6Fe_2O_3+9H_2O$.

(1) By exposing $FeCl_2+Aq$ to air. Insol. in H_2O, sl. sol. in $HCl+Aq$. (Wittstein.)

(2) From $FeCl_2+Aq$ and HNO_3. Insol. in H_2O, and sl. sol. in $HCl+Aq$. (Béchamp.)

$2Fe_2Cl_6$, $25Fe_2O_3+41H_2O$. Insol. in H_2O. (Béchamp.)

Fe_2Cl_6, $2Fe_2O_3+3H_2O$. Decomp. by H_2O with residue of Fe_2O_3; sl. sol. in dil. acids. (Rousseau, C.R. **110**. 1032.)

Fe_2Cl_6, $3Fe_2O_3$. As above. (Rousseau, C. R. **113**. 542.)

Ferric oxyfluoride, $3Fe_2O_3$, $2FeF_3+4H_2O$.

Ppt. (Scheurer-Kestner.)

Ferric oxysulphide, Fe_2O_3, $3Fe_2S_3$.

(Rammelsberg.)

Iron phosphide, FeP.

Very slowly (Freese), not (Hvoslef, A. **100**. 99) sol. in hot $HCl+Aq$. Still more insol. in dil. H_2SO_4+Aq. (Freese.)

Slowly sol. in HNO_3+Aq, and easily sol. in aqua regia. (Struve.)

Fe_2P. Slowly but completely sol. in HCl, or dil. H_2SO_4+Aq. Sol. in hot conc. H_2SO_4, in HNO_3, and in aqua regia. (Freese, Pogg. **132**. 225.)

Fe_3P_4. Very slowly sol. in hot conc. $HCl+Aq$. 0·1 g. dissolves by 4 days' heating with $HCl+Aq$; 0·3 g. dissolves in hot conc. H_2SO_4 in 1½ hours; 0·4 g. in 2 hours in HNO_3+Aq. Quite easily sol. in aqua regia on warming. (Freese.)

Fe_3P. Nearly insol. in dil. acids; rapidly sol. in HNO_3 or aqua regia; decomp. by conc. HCl, or $KOH+Aq$. (Schneider, J. B. **1886**. 2026.)

Fe_4P_3. Very slowly sol. in boiling $HCl+Aq$. Easily sol. in HNO_3 or aqua regia. (Struve, J. B. **1860**. 77.)

Mixture. (Freese, Pogg. **132**. 225.)

Ferrous selenide, $FeSe+xH_2O$.

Sol. in HCl, HNO_3, or $HC_2H_3O_2+Aq$. Insol. in alkalies, or $(NH_4)_2S+Aq$. (Reeb, J. Pharm. (4) **9**. 173.)

Ferric selenide, Fe_2Se_3.

Sol. in dil. HCl, or HNO_3+Aq with evolution of H_2Se. Sol. in conc. HNO_3+Aq. (Little, A. **112**. 211.)

Iron silicide, Fe_4Si.

Difficultly sol. in $HCl+Aq$; easily sol. even in dil. $HF+Aq$. (Hahn, A. **129**. 57.)

$Fe_{10}Si_9$. Sol. in hot $HCl+Aq$ only when most finely powdered. (Hahn.)

$FeSi_2$. Not attacked by conc. HF or H_2SO_4. (Hahn.)

Iron *semi*sulphide, Fe_2S.

Sol. in dil. acids with decomposition. (Arfvedson, Pogg. **1**. 72.)

Ferrous sulphide, FeS.

Decomp. by dil. acids, with evolution of H_2S and without separation of S, except with HNO_3+Aq.

$+xH_2O$. Sl. sol. in H_2O, especially if hot. (Berzelius.)

Very violently decomp., even by dil. acids. Sol. in H_2SO_3+Aq. Insol. in H_2S, or $(NH_4)_2S+Aq$. Sl. sol. in Na_2S, or K_2S+Aq. Sol. in Na_2S_x or K_2S_x+Aq. (de Koninck, Z. angew. Ch. **1891**. 204.)

Insol. in NH_4NO_3, or NH_4Cl+Aq. (Brett.)

Not completely pptd. in presence of Na citrate. (Spiller.)

Contrary to assertion of Persoz, it can be nearly completely pptd. in presence of $Na_4P_2O_7$ by $(NH_4)_2S+Aq$. (Rose, Pogg. **76**. 18.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. **16**. 2015.)

Sol. in $KCN+Aq$.

Colloidal.—A very dilute solution has been obtained which coagulated very readily. (Winssinger, Bull. Soc. (2) **49.** 452.)

Ferric sulphide, Fe_2S_3.

Decomp. by dil. HCl, or H_2SO_4+Aq with evolution of H_2S, leaving a residue of FeS_2.

+$1\frac{1}{2}H_2O$. Sol. in NH_4OH+Aq, also in alcoholic ammonia. Sl. sol. in $(NH_4)_2S$+very dil. $Na_2S_2O_3$+Aq. (Phipson, C. N. **30.** 139.)

Iron *di*sulphide, FeS_2.

Insol. in dil. HCl, or H_2SO_4+Aq. Decomp. by HNO_3 or aqua regia with separation of S. Insol. in a 10 % solution of alkali sulphide.

Min. *Pyrite, Marcasite.* Sol. in a mixture of Na_2S and NaOH+Aq, Na_2S+Aq, or mixture of Na_2S and NaSH+Aq; insol. in cold NaSH+Aq. Marcasite is more easily sol. in above than pyrite. (Becker, Sill. Am. J. (3) **33.** 199.)

Ferroferric sulphide, Fe_8S_9 or Fe_7S_8.

Min. *Pyrrhotite.* Sol. in dil. acids with a residue of S. Extremely slowly sol. in a 10 % solution of alkali sulphides. (Terreil, C. R. **69.** 1360.)

Ferrous nickel sulphide, 2FeS, NiS.

Min. *Pentlandite.*

Ferrous phosphorus sulphide, FeS, P_2S.

(Berzelius.)

2FeS, P_2S_3. Slowly decomp. by H_2O. Insol. in boiling HCl+Aq; decomp. by aqua regia. (Berzelius, A. **46.** 256.)

Iron potassium sulphide (potassium sulphoferrite), $K_2Fe_2S_4=K_2S, Fe_2S_3$.

Insol. in cold or hot H_2O. Violently attacked by dil. acids. Not decomp. by boiling with alkalies, alkali carbonates, or sulphides+Aq. Decomp. by KCN, or $Na_2S_2O_3$+Aq. (Preis, J. pr. **107.** 16.)

K_2S, 2FeS. (Schneider, Pogg. **136.** 460.)

Iron silver sulphide (silver sulphoferrite), Ag_2S, Fe_2S_3.

Not attacked by dil. HCl+Aq; decomp. by conc. HCl+Aq. (Schneider.)

$2Ag_2S, FeS_2$. (Schneider, Pogg. **138.** 305.)

Ag_2S, 3FeS, FeS_2. Min. *Sternbergite.* Decomp. by aqua regia.

Iron sodium sulphide (sodium sulphoferrite) $Na_2Fe_2S_4+4H_2O$.

Insol. in H_2O. Decomp. by very dil. acids (Schneider, Pogg. **138.** 302.)

Ferrous telluride, FeTe.

Insol. in H_2O; sol. in acids. (Fabre, C. R **105.** 277.)

Kermes.

See **Antimony *tri*sulphide.**

"Knallplatin" compounds.

See **Fulminoplatinum compounds.**

Lanthanum, La.

Slowly decomp. cold, rapidly hot H_2O. Not attacked by cold conc. H_2SO_4, but energetically by cold conc. HNO_3+Aq. Sol. in dil. acids. (Hillebrand and Norton, Pogg. **155.** 633.)

Lanthanum bromide, $LaBr_3+7H_2O$.

Easily sol. in H_2O. Not very sol. in absolute alcohol. Insol. in ether. (Cleve, Sv. V. A. H. Bih. **2.** No. 7.)

Lanthanum nickel bromide, $2LaBr_3, 3NiBr_2+18H_2O$.

Deliquescent. (Frerichs and Smith, A. **191.** 355.)

Lanthanum zinc bromide, $2LaBr_3, 3ZnBr_2+36H_2O$.

Very deliquescent. (F. and S.)

Lanthanum chloride, $LaCl_3$.

Anhydrous. Deliquescent. (Hermann.)

+$7\frac{1}{2}H_2O$. Not deliquescent. (Zschiesche.) Easily sol. in alcohol. (Hermann.)

Lanthanum mercuric chloride, $2LaCl_3, HgCl_2+\frac{8}{3}H_2O$.

Not deliquescent. Very sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 272.)

Lanthanum stannic chloride.

See **Chlorostannate, lanthanum.**

Lanthanum fluoride, $LaF_3+\frac{1}{2}H_2O$.

Precipitate. Sl. sol. in HCl+Aq. (Cleve.)

Lanthanum hydrogen fluoride, $2LaF_3$, 3HF.

Precipitate. (Frerichs and Smith, A. **191.** 355.) Does not exist. (Cleve, B. **11.** 910.)

Lanthanum hydride, La_2H_3.

Decomp. by dil. acids. (Winkler, B. **24.** 1966.)

Lanthanum hydroxide, $La_2O_6H_6$.

Insol. in H_2O; easily sol. in acids; insol. in KOH, or NaOH+Aq.

Lanthanum zinc iodide, $2LaI_3, 3ZnI_2+27H_2O$.

Very sol. in H_2O. (Frerichs and Smith, A. **191.** 358.)

Lanthanum oxide, La_2O_3.

Easily sol., even when ignited, in mineral, and acetic acids. (Hermann.)

Sol. in boiling conc. NH_4Cl+Aq. (Mosander.)

Sol. in cold conc. NH_4NO_3+Aq. (Damour and Deville.)

Insol. in $(NH_4)_2CO_3$+Aq. (Mosander.)

Lanthanum *per*oxide, La_4O_9.

Sol. in HCl, H_2SO_4, HNO_3, and $HC_2H_3O_2$+Aq with decomp. (Cleve, Bull. Soc. (2) **43.** 359.)

Lanthanum oxybromide, LaOBr.

Ppt. (Frerichs and Smith.)

Lanthanum oxychloride, $3La_2O_3, 2LaCl_3$.

Insol. in H_2O. Difficultly and slowly sol. in HCl, or HNO_3+Aq. (Hermann.)

LaOCl. Boiling H_2O dissolves only traces. (Frerichs and Smith.)

Lanthanum sulphide, La_2S_3.

Decomp. by H_2O and acids. (Didier.)

Lead, Pb.

Lead, in contact with H_2O and air free from CO_2, gives a solution of PbO which turns litmus blue and turmeric red, and is turned brown with H_2S.

H_2O which has been boiled does not dissolve Pb if there is no access of air. When shaken up with air it dissolves 0·01 to 0·008 % PbO in 2 hours. Pure spring water, containing 1½ grains salts in 2 pounds H_2O and no CO_2, when conducted through a lead pipe 150 feet long, dissolves so much lead that it turns brown with H_2S. (Yorke, Phil. Mag. J. **5.** 82.)

CO_2 or small amts. of salts prevent the solution of Pb. 1 vol. H_2O with ¾ vol. CO_2 dissolves only a trace of Pb. Spring H_2O, containing in 10 pounds 1·21 grains NaCl and $CaCl_2$, and 6·4 grains $CaCO_3$ dissolved in CO_2, does not dissolve lead. (Yorke.)

If the amt. of salts in solution equals $\frac{1}{3000}$ the amt. of H_2O, and especially if they are carbonates, very slight amts. of Pb are dissolved. (Christison, Phil. Mag. J. **21.** 158.)

$CaCO_3$ dissolved in CO_2 water decreases the solubility of Pb more than any other salt.

Distilled H_2O, quietly standing in a closed flask with lead and air free from CO_2, deposits white flocks of PbO_2H_2, and dissolves $\frac{1}{75000}$ pt. PbO. The solution has an alkaline reaction. (v. Bonsdorff, Pogg, **41.** 305.)

Water of 3° hardness does not take up enough Pb to become injurious. (Clarke, J. B. **1856.** 608.)

Soluble carbonates increase the solubility of Pb in H_2O (Nevins, C. C. **1851.** 608); especially $(NH_4)_2CO_3$. (Böttger.)

Presence of H_2SO_4 decreases the solubility of Pb. (Horsford, Chem. Gaz. **1849.** 247.)

H_2O containing K_2SO_4 takes up only a trace of Pb. (Wetzlar, Schw. J. **54.** 324.)

Presence of sulphates diminishes (Christison), does not diminish (Graham, Miller, and Hoffmann), the action of H_2O on Pb.

$CaSO_4$ protects Pb, but it is attacked by much $MgSO_4$. (Nevins.)

NaCl+Aq dissolves only a trace of Pb.

$\frac{1}{4000}$ pt. of a chloride in H_2O is not sufficient to prevent the solubility of Pb in H_2O. (Christison.)

Presence of chlorides increases the solubility. (Graham, Miller, and Hoffmann; Nevins.)

H_2O containing KNO_3 does not corrode Pb.

Nitrates hinder the action of H_2O. (v. Bonsdorff.) Nitrates increase the action of H_2O. (Graham, Miller, and Hoffman.) Nitrates have no influence. (Kersting.)

10 lbs. of H_2O dissolved the following amts. from Pb pipes in 24 hours: if distilled H_2O+1 % Na_2CO_3, 0·38 grain Pb; if Düna water, 0·19 grain Pb; if canal water, 0·15 grain Pb; if distilled H_2O+1 % NH_4NO_3, 0·15 grain Pb; if hard well water, 0·04 grain Pb; if distilled H_2O+1 % KNO_3, 0·01 grain Pb. (Kersting, Dingl. **169.** 183.)

200 l. Manchester drinking water dissolved 2·094 g. from 1 sq. metre Pb in 8 weeks; 9 l. well water dissolved 1·477 g. from 1 sq. metre Pb in 8 weeks; 11 l. distilled H_2O containing air dissolved 110·003 g. from 1 sq. metre Pb in 8 weeks; distilled H_2O free from air dissolved 1·829 g. from 1 sq. metre Pb in 8 weeks; sea water dissolved 0·038 g. from 1 sq. metre Pb in 8 weeks. (Calvert and Johnson, C. N. **16.** 171.)

A lead pipe taken up in Paris, which had been exposed to action of ordinary H_2O for 200 years, was found perfectly smooth and uncorroded. (Belgrand, C. R. **77.** 1055.)

Pb is attacked by all waters, hard or soft; even highly calcareous water dissolves some lead. (Mayençon and Bergeret, C. R. **78.** 484.)

Pure distilled H_2O does not act on Pb, but extremely small quantities of NH_3, HNO_3, etc. cause an action; but for this action on Pb the presence of air and CO_2 is also required. (Stallman, Dingl. **180.** 366.)

100 ccm. distilled H_2O dissolved 3 mg. from 11·8 sq. cm. lead in one week when air without CO_2 was passed through the solution. 8 mg. were dissolved when the air contained CO_2. (Wagner, Dingl. **221.** 260.)

Action of dil. salt solutions on lead. In 500 ccm. of the solutions containing salt, bright sheets of lead of 5600 sq. metres' surface were so suspended that the liquid reached all parts of the metal without hindrance, and the amts. dissolved determined after 24, 48, and 72 hours of action.

Salt	Grammes salt per litre	Dissolved Pb in mg. per litre		
		after 24	48	72 hrs.
NH_4NO_3	0·020	13·0	...	25
,,	0·040	15·0	...	32
,,	0·080	15·0	...	...
KNO_3+ $NaNO_3$	0·020 0·050	2·0	2·0	...
KNO_3+ Na_2SO_4	0·040 0·212	0·8	1·0	...
KNO_3+ K_2CO_3	0·045 0·308	...	...	0·3
KNO_3+ K_2SO_4	0·070 0·504	...	...	0·5
$CaSO_4$	0·252	0·4	...	0·8
,,	0·408	0·4	1·0	...
K_2CO_3	0·310	...	...	0·2
,,	0·516	...	...	0·2
$CaCl_2$	0·250	0·5	0·5	0·5
,,	0·510	0·3	...	0·4
Na_2SO_4	0·200	...	...	0·8
,,	0·400	...	...	0·5
NH_4NO_3+ $CaCl_2$	0·020 0·060	...	...	1·8
NH_4NO_3+ K_2CO_3+ Na_2SO_4	0·020 0·100 0·200	...	...	0·4
Na_2SO_4+ K_2CO_3+ $CaCl_2$	0·200 0·040 0·100	...	...	0·1
Water from L. Katrine		1·0	1·0	1·5
Distilled water . .		2·0	2·0	3·0

(Muir, C. N. **25.** 294.)

Action of salt solutions on 11·8 sq. cm. Pb in one week while air either with or without CO_2 was passed through the solution.

100 ccm. solutions containing the given amts. salts dissolve Pb in mg.:—

Salt	g. salt in 100 ccm.	mg. Pb dissolved	
		without CO_2	with CO_2
KCl	0·5	21	12
NaCl	0·5	21	12
NH_4Cl	1·0	12	5
$MgCl_2$	0·83	20	35
K_2SO_4	1·0	0	0
KNO_3	1·0	14	20
Na_2CO_3	1·0	0	...
NaOH	0·923	430	...
CaO_2H_2	Saturated	137	...

(Wagner, Dingl. 22

Solubility of Pb in salt solutions.

25 sq. cm. were acted upon by a solution containing 0·2 g. salt in a litre for 21 days.

Three series of experiments were carried on. I. In corked flasks. II. In beakers covered with porous paper; diameter of mouth of beaker =11·5 cm. III. In basins covered with porous paper; diameter of mouth of basin=14·5 cm. IV. In corked flasks with constant current of air. V. In beakers half filled and covered with porous paper, the lead being suspended so that equal amts. of surface were above and beneath the liquid.

The amts. in mgs. of Pb dissolved were as follows:—

Salt used	I.	II.	III.	IV.	V.
NH_4NO_3 .	1·8	4·0	16·0	...	...
KNO_3 . .	1·6	0·5	6·0	1·5	...
$CaCl_2$ . .	3·0	2·8	5·5	3·5	3·5
$(NH_4)_2SO_4$.	0·7	1·3	16·0	5·0	2·5
K_2CO_3 . .	0·3	0·3	0·7	0·6	0·3
Dist. H_2O .	1·5	0·8	4·2	2·0	...

(Muir, Chem. Soc. **36.** 660.)

H_2O sat. with CO_2 dissolves 0·012 g. Pb to a litre in 3 days. (Marais, C. R. **77.** 1529.)

Action of H_2O charged with CO_2 under 760 mm. pressure on Pb. 3 mg. of Pb were dissolved per litre in 24 hours, and the amt. was not increased by further action. The addition of 100 mg. K_2CO_3+20 mg. NH_4NO_3 to a litre prevented all action.

Action of H_2O charged with CO_2 under 6 atmos. pressure on Pb.

14·8 mg. were dissolved per l. in 24 hours, and 24 mg. per l. in 48 hours.

Action of various salt solutions added to above solution of CO_2 was as follows:—

	mg. salt per l.	mg. Pb dissolved	
		after 24 hrs.	after 48 hrs.
K_2CO_3 . . .	80	13·2	32·0
K_2CO_3 . . .	160	...	6·0
$CaCl_2$ . . .	160	32·0	44·0
NH_4NO_3 . .	16	5·0	...
NH_4NO_3 . .	40	10·0	35·0
Distilled H_2O	...	14·8	24·0

(Muir, C. N. **33.** 125.)

The corrosion of Pb by ordinary distilled H_2O depends upon the presence of CO_2 and O. If the dissolved CO_2 is double the amt. of the dissolved O, the action is most energetic. When CO_2 is wholly absent and O present, the action is very slight, and when the H_2O contains 1½ or more vol. % CO_2 with normal amt. of oxygen, there is no visible corrosion. Pure distilled H_2O containing neither O nor CO_2 has no action on Pb. In the above cases the greater part of the Pb remains in the form of a white ppt. or crust on the Pb, but in the case where O and CO_2 are both present in the ratio of 1 : 2, very small amts. of Pb go into solution in a few days; the amt., however, diminishes on standing. As the amt. of CO_2 increases, the amt. of Pb dissolved in the H_2O also increases.

NH_4OH alone does not protect Pb from corrosion, but when in combination with CO_2 the action is much diminished.

CaO_2H_2, and NaOH + Aq attack Pb much more actively in absence of CO_2 and presence of air. In absence of dissolved O neither CaO_2H_2 nor NaOH attacks Pb.

Na_2CO_3+Aq in absence of CO_2 attacks Pb slightly, but $NaHCO_3$+Aq has not the slighest action.

$CaH_2(CO_3)_2$ + Aq also has not the slightest action on Pb, and the presence of $CaCO_3$ and CO_2 wholly prevents H_2O attacking Pb.

$CaSO_4$+Aq in presence of air forms a crust on Pb, but no Pb is found in solution, but if air is excluded there is no visible action. Presence of CO_2 causes a strong corrosive action.

H_2O containing $CaSO_4$ and $CaH_2(CO_3)_2$ does not attack Pb.

The above reactions are not in the least altered by the presence of moderate amts. of nitrates, chlorides, or ammonium, or organic compounds; but ammonium salts in excess have a strong solvent action on Pb. (Müller, J. pr. (2) **36.** 317.)

See also an extended report of the action of H_2O on Pb made to the Water Committee of Huddersfield, England, in 1886, by Messrs. Crookes, Odling, and Tidy.

Very extended researches are published by Cornelley and Frew (Jour. Soc. Chem. Ind. **7.** 15), of which only the general conclusions can be given here.

The action of slaked lime, limestone, sand, calcium silicate, mortar, etc., was tested. The results were as follows:—

1. In nearly all cases the corrosion is greater with free exposure to the air than when air is excluded. The difference is especially great in those cases where the greatest action on the lead takes place. Aluminum hydroxide and blue clay form exceptions, and exert a greater corrosive action when air is excluded. In the case of $CaCO_3$, old mortar, $CaSiO_3$, or a mixture of $CaCO_3$ and CaO_2H_2, the exclusion or presence of air makes no appreciable difference.

KNO_3+Aq show a peculiar behaviour. In the presence of air it acts nearly as much on the Pb as pure H_2O, but when air is excluded it exerts nearly as much retarding action as $CaSiO_3$.

2. In the presence of air the action of H_2O on Pb is considerably increased by the presence of NH_4NO_3 or CaO_2H_4; with exclusion of air, by $CaSO_4$, also by a mixture of CaO_2H_2 and sand. All the other investigated substances, even KNO_3, hinder the action of H_2O on Pb either with or without exclusion of air.

3. CaO_2H_2+Aq exerts in all cases a much greater corrosive action than pure H_2O, and although this action is diminished by sand yet fresh mortar very quickly destroys lead pipes when in contact therewith. Old mortar, on

the other hand, and also $CaSiO_3$ and $CaCO_3$, have a protective action.

4. The fact is very important that sand, $CaCO_3$, old mortar, $CaSiO_3$, and a mixture of sand and $CaCO_3$ afford considerable protection to lead against H_2O. A mixture of limestone and sandstone has more effect than the two substances separately.

5. $CaSiO_3$ totally prevents the corrosive action of KNO_3 and NH_4NO_3, so that the lead is not attacked by solutions of those salts any more than by H_2O containing $CaSiO_3$ alone. Sand, and a mixture of sand and $CaCO_3$ have a similar effect, but not to such a degree.

6. The protective influence of $CaCO_3$ does not appear to depend on the presence of CO_2 and the formation of $CaH_2(CO_3)_2$.

7. $MgCO_3$ prevents the corrosion of Pb as much as $CaSiO_3$. (Carnelley and Frew, Jour. Soc. Chem. Ind. **7**. 15.)

Pb in contact with Zn or Fe is protected thereby from the solvent action of H_2O, and in fact the action is nearly null. Sn, on the other hand, increases the action. This is of importance in regard to the use of tin-coated lead pipes.

The presence of Ca salts does not influence the action of the H_2O on Pb, hard or soft H_2O *provided it contains* CO_2 having a strong corrosive action. Removal of air from H_2O diminishes the solvent action. Simple filtration will remove all Pb from H_2O if suitable filters are used. (Flögel, J. B. **1888**. 2645.)

Pure distilled H_2O has strong corrosive action on Pb, which is very much weakened by addition of a solution of $CaCO_3$ in carbonic acid water, but the presence of sulphates increase the action. Pb is not appreciably attacked by H_2O in presence of chlorides alone, but very strongly when $CaSO_4$ is also present. H_2O containing CO_2 also corrodes Pb. The conclusion was drawn that the absence of action of H_2O on Pb in lead pipes is due to the presence of traces of $CaH_2(CO_3)_2$. (Barbaglia and Gucci, C. C. **1888**. 934.)

Almost insol. in cold $HCl+Aq$, and only sl. attacked when boiling. Completely sol. in HNO_3+Aq if not too conc., but presence of H_2SO_4 or HCl diminishes the solvent power to a great extent. (Rose.)

Granulated Pb is sl. sol. in conc. $HCl+Aq$; addition of $PtCl_4$ makes the action very energetic. Dil. $HCl+Aq$ may also be used with $PtCl_4$. (Millon, C. R. **21**. 49.)

Scarcely acted upon by boiling conc. $HCl+Aq$. Sol. in aqua regia. HNO_3+Aq is the best solvent, but Pb is as good as insol. in a mixture of HNO_3 and H_2SO_4. (Berzelius.)

Not acted upon by very conc. HNO_3+Aq.

Quickly decomp. by hot $HCl+Aq$, slowly by cold. (Sharples, C. N. **50**. 126.)

Pb is only sl. attacked by HNO_3+Aq of any strength below 15°. Above 15° it is most rapidly attacked by a rather weak acid. (Montemartini, Gazz. ch. it. **22**. 397.)

Action of H_2SO_4 on Pb.

H_2SO_4 of 1·842 sp. gr. dissolves 201 g. from 1 sq. metre pure lead at ordinary temp. (time ?), and H_2SO_4 of 1·705 sp. gr. dissolves only 59 g. Slight impurities in the lead lessen this solubility. (Calvert and Johnson, Chem. Soc. (2) **1**. 66.)

Strongly attacked by 99·8 % H_2SO_4 at ord. temp. with exclusion of air. (Lunge, Dingl. **261**. 131.)

When 0·2 g. pure Pb was heated with 50 ccm. H_2SO_4 of 66° B. there was no appreciable action below 175°. At 230-250° all the Pb was suddenly converted into $PbSO_4$, which dissolved. (Bauer, B. **8**. 210.)

Lead is slowly attacked by pure cold conc. H_2SO_4+Aq (99·78 % H_2SO_4). Lead vessels which held the HS_2O_4 were gradually destroyed by long standing. (Napier and Tatlock, C. N. **42**. 314.)

$HCl+Aq$ of 1·2 sp. gr., with Pb, gives off H at ord. temp., more abundantly when heated. Evolution of H is hastened by placing Cu in contact with the Pb.

H_2SO_4+Aq (20 %) does not evolve H under the same circumstances. (Stolba, J. pr. **94**. 113.)

Sol. in $HC_2H_3O_2+Aq$ when in contact with the air.

Somewhat sol. in $NaCl+Aq$. (Reichelt, Dingl. **172**. 155.)

$NaCl+Aq$ attacks Pb at high temp. (Lunge, *l.c.*)

Action of $KClO_3$. $KClO_3+Aq$ (6·3 % $KClO_3$) oxidised 64·31 g. Pb from 1 sq. metre surface by boiling 7 hours; $KClO_3+Aq$ (25 % $KClO_3$) oxidised 151·12 g. under same conditions; and $Ca(ClO_3)_2$, $CaCl_2+Aq$ (20° Baumé), obtained by passing Cl_2 through CaO_2H_2+Aq, oxidised 437·70 g. (Lunge and Deggeler, Jour. Soc. Chem. Ind. **4**. 31.)

Solubility of Pb in petroleum.

If b.-pt. is under 230°, only slightest trace is dissolved in 4 months; if 230-300°, 0·0026 % in 4 months; if over 300°, 0·0244 % in 4 months.

Solubility of Pb in commercial oil of turpentine and resin oil.

	Temp.	% Pb dissolved	
		in 8 days	in 14 days
Fresh oil of turpentine .	15-20°	sl. trace	0·0722
Old oil of turpentine . .	15-20	0·0522	0·1435
Fresh oil of turpentine .	100	0·265	0·715
Old oil of turpentine . .	100	0·982	1·851
Fresh oil of turpentine .	130-150	0·938	2·045
Old oil of turpentine . .	130-150	1·738	4·083
Fresh resin oil	15-20	trace	0·024
Old ,,	15-20	0·073	0·185
Fresh ,,	100	0·380	0·880
Old ,,	100	1·190	2·711
Fresh ,,	130-150	1·050	2·065
Old ,,	130-150	2·208	4·740

(Engler and Kneis, Dingl. **263**. 193

Pb is strongly attacked by oil of turpentine. (Am. Chem. **4.** 289.)

The fatty oils dissolve Pb in considerable amt. (Macadam, J. B. **1878.** 1169.)

Not attacked by sugar +Aq. (Klein and Berg, C. R. **102.** 1176.)

Lead azoimide, PbN_6.

Insol. in cold H_2O; much less sol. in boiling H_2O than $PbCl_2$. 1 l. H_2O dissolves about $\frac{1}{2}$ g. PbN_6. Easily sol. in warm $HC_2H_3O_2$+Aq. Insol. in conc. NH_4OH+Aq. (Curtius, B. **24.** 3344.)

Lead bromide, $PbBr_2$.

Sl. sol. in cold, more easily in hot H_2O, or in H_2O containing HCl, HNO_3, or $HC_2H_3O_2$. (Löwig.)

1 l. H_2O dissolves 6 g. $PbBr_2$ at 10°; addition of HBr causes a ppt. which redissolves on further addition of HBr. 1000 pts. of a liquid containing 720 pts. HBr dissolve 550 g. $PbBr_2$. This solubility increases by heating. (Ditte, C. R. **92.** 718.)

Slowly sol. in cold, easily in warm NH_4Cl, or NH_4NO_3+Aq. (Wittstein.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in benzene. (Franchimont, B. **16.** 387.)

$+3H_2O$. (Ditte, *l.c.*)

Lead hydrogen bromide, $5PbBr_2$, $2HBr + 10H_2O$.

Sol. in HBr+Aq. (Ditte, C. R. **92.** 718.)

Lead magnesium bromide, $PbBr_2$, $2MgBr_2 + 16H_2O$.

Very deliquescent. Decomp. immediately by H_2O or alcohol. (Otto and Drewes, Arch. Pharm. **229.** 585.)

Lead potassium bromide (potassium bromoplumbite), $PbBr_2$, $KBr + H_2O$.

(Remsen and Herty, Am. Ch. J. **14.** 124.)

$+\frac{1}{3}H_2O$. (Wells, Sill. Am. J. **145.** 129.)

$PbBr_2$, 2KBr. Sol. in a little H_2O without decomp., but decomp. by an excess with separation of $PbBr_2$. (Löwig.)

$+H_2O$. (Wells, Sill. Am. J. **145.** 129.)

$2PbBr_2$, KBr. (Wells.)

Lead potassium *per*bromide, $K_3Pb_2Br_8 + 4H_2O$.

Decomp. by H_2O and alcohol. (Wells, Z. anorg. **4.** 340.)

Lead rubidium bromide, $PbBr_2$, $2RbBr + \frac{1}{2}H_2O$.

(Wells, Sill. Am. J. **146.** 34.)

$2PbBr_2$, RbBr. (Wells.)

Lead sodium bromide.

Decomp. by H_2O. (Löwig.)

Lead bromochloride, $PbBrCl = PbBr_2$, $PbCl_2$.

Can be recrystallised from H_2O without decomp. (Iles, C. N. **43.** 216.)

Lead bromoiodide, $PbBrI = PbBr_2$, PbI_2.

Decomp. by H_2O. Cryst. from a solution of PbI_2 in HBr. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

$3PbBr_2$, PbI_2. (G. and T.)

$6PbBr_2$, PbI_2. (G. and T.)

Lead bromosulphide, $PbBr_2$, PbS.

Properties as chlorosulphide. (Parmentier.)

Lead chloride, $PbCl_2$.

Slowly sol. in 135 pts. H_2O at 12·5°, and in a much smaller quantity of hot H_2O. (Bischof.)

Sol. in 30 pts. cold, and 22 pts. hot H_2O. (Wittstein.)

Sol. in 30 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O dissolve 4·59 pts. $PbCl_2$ at 15·5°. (Ure's Dict.)

100 pts. H_2O dissolve 0·9712 pt. $PbCl_2$ at 20°. (Formánek, C. C. **1887.** 270.)

100 pts. H_2O dissolve 0·946 pt. $PbCl_2$ at 17·7°. (Bell, Chem. Soc. (2) **6.** 355.)

Sol. in 105·2 pts. H_2O at 16·5°. (Bell, C. N. **16.** 69.)

100 pts. H_2O dissolve 0·8 pt. $PbCl_2$ at 0°; 1·18 pts. at 20°; 1·7 pts. at 40°; 2·1 pts. at 55°; 3·1 pts. at 80°. (Ditte, C. R. **92.** 718.)

$PbCl_2$ is sol. in 120 pts. pure H_2O, but on adding 5 % NaCl 437 pts. are required to effect solution. When $PbCl_2$ is digested with conc. NaCl+Aq, 1 pt. dissolves in 129 pts. of the liquid.

Solubility in H_2O is not much increased by the addition of acids. (Fresenius.)

Sol. in conc. HCl+Aq, from which it is pptd. by H_2O, but less sol. in dil. HCl+Aq than in H_2O. (Berzelius.)

Sol. in 1636 pts. H_2O containing HCl. (Bischof.)

Sat. solution of $PbCl_2$ in HCl+Aq of 1·116 sp. gr. contains 2·566 % $PbCl_2$ at 16·5°.

Solubility in HCl+Aq. 100 pts. liquid containing pts. HCl of 1·1162 sp. gr. in 100 pts. H_2O dissolve pts. $PbCl_2$ at 17·7°.

Pts. HCl	Pts. $PbCl_2$	Pts. HCl	Pts. $PbCl_2$	Pts. HCl	Pts. $PbCl_2$
1	0·347	8	0·099	50	0·356
2	0·201	9	0·096	60	0·559
3	0·165	10	0·093	70	0·933
4	0·145	15	0·090	80	1·498
5	0·131	20	0·111	90	2·117
6	0·107	30	0·151	100	2·900
7	0·100	40	0·216	...	...

(Bell, Chem. Soc. **21.** 350.)

Solubility of $PbCl_2$ in HCl.

Amt. HCl in 100 pts. H_2O	Amount $PbCl_2$ dissolved in 1000 pts. of liquid				
	At 0°	At 20°	At 40°	At 55°	At 80°
0·0	8·0	11·8	17·0	21·0	31·0
5·6	2·8	3·0	4·6	6·5	12·4
10·0	1·2	1·4	3·2	5·5	12·0
18·0	2·4	4·8	7·2	9·8	19·8
21·9	4·7	6·2	10·4	12·9	23·8
31·5	11·9	14·1	19·0	24·0	38·0
46·0	29·8	30·0	...	...	...

(Ditte, C. R. **92.** 718.)

Solubility in HCl+Aq at 0°. $\frac{PbCl_2}{2} = \frac{1}{2}$ mols. $PbCl_2$ in mgs. in 10 ccm. solution; HCl = mols. HCl in ditto.

$\frac{PbCl_2}{2}$	HCl	$\frac{PbCl_2}{2}$	HCl
0·42	0·	0·072	5·8
0·22	0·35	0·088	11·7
0·135	0·675	0·100	29·5
0·11	1·125	0·209	46·7
0·105	1·6	0·95	73·5
0·099	2·3	1·5	89·0
0·090	3·4	1·9	96·0
0·08	4·5	3·01	111·5

It is seen that very little HCl+Aq is sufficient to diminish solubility very considerably, and, that on further addition of HCl+Aq, the solubility is nearly constant, and increases finally very much when large amts. of HCl+Aq are present. (Engel, A. ch. (6) **17.** 359.)

Sol. in hot, insol. in cold conc. H_2SO_4. (Hayes.)

Sol. in dil. HNO_3+Aq, from which it is pptd. by HCl+Aq. (Gladstone.)

Easily and completely decomp. by hot HNO_3+Aq. (Wurtz.)

Sol. in KOH+Aq. (Rose.)

Less sol. in dil. salt solutions than in H_2O, especially $CaCl_2$+Aq; sol. in 534 pts. H_2O containing $CaCl_2$. (Bischof.)

More sol. in $Na_2S_2O_3$+Aq than in H_2O, but not as sol. as AgCl. (Herschell, **1819.**)

More sol. in $NaC_2H_3O_2$+Aq than in H_2O. (Anthon.)

Easily sol. in NH_4NO_3+Aq.

Much more sol. in $HgCl_2$+Aq than in H_2O.

Grammes $HgCl_2$ in 100 ccm.	Grammes $PbCl_2$ dissolved	After subtracting amt. dissolved by H_2O alone	Calculated no. of grammes for 100 g. $HgCl_2$
0	0·9712	...	...
4	1·8972	0·9350	23·37
2	1·4874	0·5208	26·04
1	1·2272	0·2600	26·00
0·5	1·0808	0·1134	22·68
0·25	1·0192	0·0500	20·00
0·125	0·9926	0·0226	18·08

(Formánek, C. C. **1887.** 270.)

Insol. in conc. alcohol. (Wittstein.) Insol. in 94 % alcohol; very sl. sol. in cold or hot 76 % alcohol.

Insol. in benzene. (Franchimont, B. **16.** 387.)

Glycerine dissolves 1·995 % $PbCl_2$.

1 pt. glycerine+1 pt. H_2O dissolves 1·32 % $PbCl_2$.

1 pt. glycerine+3 pts. H_2O dissolves 1·0365 % $PbCl_2$.

Glycerine containing 87·5 % H_2O dissolves 0·91 % $PbCl_2$. (Piesse, B. **7.** 599.)

Min. *Cotunnite.*

Lead *tetra*chloride, $PbCl_4$.

Sol. in H_2O with subsequent decomp. (Rivot, Beudant, and Daguin, Ann. Min. (5) **4.** 239.)

Obtained in a pure state by Friedrich. Sol. in a little cold H_2O, but is decomp. by warming or diluting. Miscible with conc. HCl+Aq; not attacked by conc. H_2SO_4 even on warming. (Friedrich, W. A. B. **102, 2b.** 534.)

Lead *tetra*chloride *with* MCl.

See **Chloroplumbate, M.**

Lead magnesium chloride, $PbCl_2$, $2MgCl_2+13H_2O$.

Deliquescent. Decomp. by H_2O. (Otto and Drewes, Arch. Pharm. **228.** 495.)

Lead potassium chloride (potassium chloroplumbite), $PbCl_2$, KCl.

(Remsen and Herty, Am. Ch. J. **14.** 125.)

Contains $\frac{1}{3}$ H_2O. (Wells, Sill. Am. J. **145** 130.)

$2PbCl_2$, KCl. (Wells.)

Lead rhodium chloride.

See **Chlororhodite, lead.**

Lead rubidium chloride, $PbCl_2$, $2RbCl+\frac{1}{2}H_2O$.

(Wells, Sill. Am. J. **146.** 34.)

$2PbCl_2$, RbCl. (Wells.)

Lead sodium chloride.

Decomp. by H_2O.

Lead sodium *tetra*chloride, $2PbCl_4$, 9NaCl.

Very sol. in H_2O. (Sobrero and Selmi, A. ch. (3) **29.** 165.)

See also **Chloroplumbate, lead.**

Lead thallous chloride, $PbCl_2$, 3TlCl.

Sl. sol. in cold, more in hot H_2O. (Noyes, Z. phys. Ch. **9.** 622.)

Lead chloride ammonia, $2PbCl_2$, $3NH_3$.

(Rose, Pogg. **20.** 157.)

Lead chloride arsenate, $3Pb_3(AsO_4)_2$, $PbCl_2$.

See **Arsenate chloride, lead.**

Lead chloride borate, $Pb(BO_2)_2$, $PbCl_2+H_2O$.

See **Borate chloride, lead.**

Lead chloride carbonate.

See **Carbonate chloride, lead.**

Lead chloride chlorite.

See **Chlorite chloride, lead.**

Lead chloride *with* fluoride *and* iodide.

See **Lead chlorofluoride** *and* **Lead chloroiodide.**

Lead chloride phosphate.

See **Phosphate chloride, lead.**

Lead chloride phosphite, $PbCl_2$, $Pb_2P_2O_5$ (?).

Ppt. (Berzelius.)

Does not exist. (Rose.)

Lead chloride sulphate.

See **Sulphate chloride, lead.**

Lead chloride sulphide, $PbCl_2$, 3PbS.

See **Lead chlorosulphide.**

Lead chlorofluoride, $PbClF = PbCl_2, PbF_2$.

Sl. sol. in H_2O without decomp. Easily sol. in $HNO_3 + Aq$. (Berzelius.)

Lead chloroiodide, $2PbCl_2, PbI_2$.

Sol. in hot $NH_4Cl + Aq$. (Poggiale, J. pr. **35.** 329.)

$PbCl_2, PbI_2$. Sol. in hot $HCl + Aq$. (Engelhardt.)

Lead chlorosulphide, $PbCl_2, 3PbS$.

Partially decomp. by hot H_2O. Not attacked by dil., but decomp. by conc. $HCl + Aq$. (Hünefeld, J. pr. **7.** 27.)

$PbS, PbCl_2$. Decomp. by H_2O, acids, or alkalies. (Parmentier, C. R. **114.** 298.)

Lead fluoride, PbF_2.

Very sl. sol. in H_2O, and not more in $HF + Aq$. (Berzelius, Pogg. **1.** 31.)

More sol. in HNO_3, or $HCl + Aq$. Sl. sol. in $KF + Aq$. (Herty, Am. Ch. J. **14.** 107.)

Lead tantalum fluoride.

See **Fluotantalate, lead.**

Lead titanium fluoride.

See **Fluotitanate, lead.**

Lead fluoride sulphate.

See **Sulphate fluoride, lead.**

Lead hydroxide, PbO, PbO_2H_2.

(Schaffner, A. **51.** 175.)

$2PbO, PbO_2H_2 = 3PbO, H_2O$. Sol. in 10,000 to 12,000 pts. H_2O. (Yorke.) Sol. in 7000 pts. H_2O. (v. Bonsdorff, Pogg. **41.** 307.)

Sol. in acids. Insol. in $NH_4OH + Aq$. Sol. in NaOH, or $KOH + Aq$. Sol. in hot $NH_4Cl + Aq$, and repptd. by $NH_4OH + Aq$.

Solubility in $KOH + Aq$, according to Ditte (C. R. **94.** 130). When $KOH + Aq$ is gradually added to lead hydroxide suspended in H_2O, the lead hydroxide is at first dissolved proportional to the amount of KOH, until the strength reaches 200 g. KOH to 1 litre H_2O. The solubility then diminishes and increases again until 400 g. KOH are dissolved in 1 litre H_2O. The amorphous lead hydroxide is then converted into crystalline $2PbO(PbO_2H_2)$. By further addition of KOH the solubility is suddenly decreased, and then increases again. (Ditte.)

Sol. in triethyl toluenyl ammonium hydrate + Aq.

Sol. in sorbine + Aq. (Pelouze.)

Sol. in acetates + Aq. (Mercer.)

Sol. in Ca, Ba, Sr, K, or Na sucrate + Aq.

Not pptd. in presence of Na citrate + Aq. (Spiller.)

See also under **Lead,** *and* **Lead oxide.**

Lead *per*hydroxide, PbO_2, H_2O.

See **Lead *per*oxide.**

Lead iodide, PbI_2.

Sol. in 187 pts. boiling H_2O. (Berthemot.)

Sol. in 1235 pts. H_2O at ord. temp., and 194 pts. at 100°. (Denot, J. pr. **1.** 425.)

Sol. in 2400 pts. H_2O at 18·75°. (Abl.)

Sat. $PbI_2 + Aq$ at 20° contains 0·0017 pt.; at 27°, 0·002 pt.; at 100°, 0·0039 pt. PbI_2. (Lassaigne, J. chim. méd. **7.** 364.)

1 l. H_2O dissolves 0·6 g. PbI_2 at 10°. (Ditte, C. R. **92.** 718.)

Not more sol. in $HC_2H_3O_2 + Aq$ than in H_2O, contrary to Henry. (Denot, *l.c.*)

Pptd. from aqueous solution by little $HI + Aq$, but redissolved by the addition of more. (Ditte, C. R. **92.** 718.)

Insol. in cold, sol. in hot $HCl + Aq$ with decomp.

Sol. in $KOH + Aq$.

Sol. in conc. KI, NaI, BaI_2, SrI_2, CaI_2, and $MgI_2 + Aq$, from which it is pptd. by H_2O. (Berthemot.)

Very sol. in $KI + Aq$, 2 mols. PbI_2 being dissolved for 1 mol. KI. (Boullay.)

Sol. in $NH_4I + Aq$. Easily sol. in $Na_2S_2O_3 + Aq$. (Werner, C. N. **53.** 51.)

Not pptd. in presence of Na citrate. (Spiller.)

Sl. sol. in alcohol. (Henry.) Decomp. by boiling ether. (Vogel.)

Lead hydrogen iodide, $PbH_2I_4 = PbI_2, 2HI$.

Cold H_2O dissolves out HI. Sol. in hot H_2O, from which crystallises PbI_2. (Guyot, J. chim. méd. **12.** 247.)

$+10H_2O$. Decomp. by H_2O. (Berthelot, C. R. **91.** 1024.)

Lead magnesium iodide, $PbI_2, 2MgI_2 + 16H_2O$.

Very hygroscopic. Decomp. immediately by H_2O. (Otto and Drewes, Arch. Pharm. **229.** 180.)

Lead potassium iodide (**Potassium iodoplumbite**), PbI_2, KI.

Permanent. Completely decomp. by H_2O. Unacted upon by cold, but completely decomp. by hot alcohol. (Boullay, A. ch. (2) **34.** 366.)

$+2H_2O$. The only salt that could be obtained by Remsen and Herty (Am. Ch. J. **14.** 110.)

$PbI_2, 2KI + 2H_2O$. Decomp. by H_2O. (Berthelot, A. ch. (5) **29.** 289.)

Does not exist. (R. and H.)

$+4H_2O$. (Ditte, C. R. **92.** 134.) Does not exist. (R. and H.)

$PbI_2, 4KI$. Decomp. by H_2O; insol. in alcohol. (Boullay.) Does not exist. (R. and H.)

$3PbI_2, 4KI + 6H_2O$. (Berthelot, *l.c.*) Does not exist. (R. and H.)

Lead potassium *per*iodide, $K_3Pb_2I_8 + 4H_2O$.

Decomp. by H_2O or alcohol. (Wells, Z. anorg. **4.** 346.)

Lead rubidium iodide, $PbI_2, RbI + 2H_2O$.

(Wells, Sill. Am. J. **146.** 34.)

Lead sodium iodide, PbI_2, NaI.

Decomp. by H_2O. (Poggiale, C. R. **20.** 1180.)

$+xH_2O$. (Remsen and Herty, Am. Ch. J. **14.** 124.)

Lead iodide ammonia, $PbI_2, 2NH_3$.

Decomp. by H_2O. (Rammelsberg, Pogg. **48.** 166.)

Lead iodide carbonate.

See **Carbonate iodide, lead.**

Lead *sub*oxide, Pb_2O.

Decomp. by H_2O into PbO_2H_2.

Decomp. by dil. H_2SO_4, HCl, HNO_3, $HC_2H_3O_2+Aq$, or alkalies, into PbO, which dissolves, and Pb, which dissolves or not, according to the reagent. Sol. in dil. $Pb(NO_3)_2+Aq$.

Lead *mon*oxide (Litharge), PbO.

Sol. in 7000 pts. H_2O. (Horsford.)

Pure PbO is insol. in H_2O. (Brandecke, Repert. **53.** 155; Siebold, Repert, **53.** 174; Herbergen, Repert. **55.** 55.) Sl. sol. in H_2O. (Yorke, Phil. Mag. (3) **5.** 82.)

Easily sol. in acids.

Sol. in KOH, or $NaOH+Aq$; also in CaO_2H_2+Aq.

Sol. in NH_4Cl+Aq; sl. sol. in NH_4NO_3+Aq.

Sol. in $CaCl_2$, and $SrCl_2+Aq$. (André, C. R. **104.** 359.)

Sol. in $MgCl_2+Aq$. (Voigt, Ch. Ztg. **13.** 695.)

Sol. in boiling $Cu(NO_3)_2$ with pptn. of CuO.

Partially sol. in $Cd(NO_3)_2$, and $Mn(NO_3)_2$ with pptn. of CdO and MnO respectively.

Not acted upon by Mg, Ag, Co, Ni, or Ce nitrates $+Aq$. (Persoz.)

Very sol. in $Pb(C_2H_3O_2)_2+Aq$. (Rochleder.)

When finely pulverised, sol. in cane sugar $+Aq$, but less than Pb_3O_4. (Peschier.)

Sl. sol. in glycerine. Readily sol. in glucose $+Aq$. (Persoz.)

Sol. in volatile oils. (Schweitzer.)

See also **Lead.**

Min. *Massicot.*

Lead oxide (Red lead), Pb_3O_4.

Insol. in H_2O.

Converted by acids into PbO_2 and salts of *mon*oxide.

Sol. in a large amt. of glacial acetic acid. (Berzelius.) Insol. in acetic acid. (Schönbein, J. pr. **74.** 325.)

Solution in $HC_2H_3O_2+Aq$ may decompose or not according to concentration of acid. When treated with an excess of $HC_2H_3O_2+Aq$ of 8° B, Pb_3O_4 is quickly dissolved, but the solution soon deposits PbO_2; this decomposition is facilitated by dilution. But if Pb_3O_4 is treated with a large excess of glacial $HC_2H_3O_2$, it dissolves, and the solution is permanent if atmospheric air is excluded, and temp. does not rise above 40°. (Jacquelain, J. pr. **53.** 152.)

Easily sol. in cane sugar $+Aq$. (Peschier.)

Min. *Minium.*

Lead *sesqui*oxide, Pb_2O_3.

Insol. in H_2O or in $KOH+Aq$.

Decomp. by strong acids into PbO_2 and corresponding salt of *mon*oxide.

Lead *per*oxide, PbO_2.

Insol. in H_2O. Sol. in acids, also in conc. alkali hydroxides $+Aq$. The solutions in acids are very unstable, except when concentrated and kept at a low temperature.

Decomp. by cold HCl, HCN, HBr, and $HI+Aq$. Not attacked by other acids when cold, but decomp. thereby when hot. Insol. in moderately conc. HNO_3, H_2SO_4, or $HC_2H_3O_2+Aq$.

Decomp. by NH_4OH+Aq. Sol. in conc. KOH, or $NaOH+Aq$.

Sol. with decomp. in $Hg_2(NO_3)_2+Aq$. (Levol.)

Min. *Plattnerite.*

Lead manganese *per*oxide, PbO_2, $4MnO_2$.

Ppt. (Gibbs and Parkmann, Sill. Am. J. (2) **39.** 58.)

Lead oxybromide, $PbBr_2$, PbO.

Insol. in H_2O.

+1, $1\frac{1}{2}$, and $3H_2O$. (André, C. R. **96.** 1502.)

Lead oxychloride, $2PbCl_2$, $PbO+2H_2O$.

(André, C. R. **96.** 435.)

$PbCl_2$, PbO. Absolutely insol. in hot or cold H_2O. (André, A. ch. (6) **3.** 108.)

Min. *Matlockite.*

$+H_2O$. Sol. in hot $NaOH+Aq$. (André.)

$PbCl_2$, $2PbO$. Insol. in H_2O. Sol. in dil. $KOH+Aq$ (abont 110 g. in 1 l.) (Ditte, C. R. **94.** 1180.)

Min. *Mendipite.* Easily sol. in HNO_3+Aq.

$+2H_2O$. (André, A. ch. (6) **3.** 111.)

$PbCl_2$, $3PbO$. Insol. in H_2O. (Döbereiner.)

$+H_2O$. (Wood and Borden, C. N. **52.** 43.)

$+3H_2O$. Ppt. (André, C. R. **104.** 359.)

$+4H_2O$. Nearly insol. in H_2O. Sl. sol. in $NaOH+Aq$. (Vauquelin.)

$PbCl_2$, $5PbO$. (Döbereiner.)

$PbCl_2$, $7PbO$. *Cassel-yellow.*

Lead strontium oxychloride, $2PbO$, $SrCl_2+5H_2O$.

(André, C. R. **104.** 359.)

Lead oxychloride iodide, $PbCl_2$, PbI_2, $4PbO$.

Min. *Schwartzembergite.* Sol. in dil. HNO_3+Aq.

Lead oxyiodide, PbI_2, PbO.

Insol. in boiling H_2O or $KI+Aq$. (Brandes, A. **10.** 269.)

$+\frac{1}{2}H_2O$. (Ditte, C. R. **92.** 145.)

$+H_2O$.

PbI_2, $2PbO$. Insol. in H_2O. (Denot, J. Pharm. **20.** 1.)

$+H_2O$.

PbI_2, $3PbO+2H_2O$. Ppt. (Kühn, C. C. **1847.** 593.)

PbI_2, $5PbO$. Insol. in H_2O. (Denot.)

$+7H_2O$. (Ditte, C. R. **92.** 145.)

Lead oxy*per*iodide, PbO, PbI_2I_3.

Decomp. by boiling H_2O. Sol. in dil. $HC_2H_3O_2+Aq$. (Gröger, W. A. B. **100, 2b.** 415.)

Lead phosphoselenide, $PbSe$, P_2Se.

Insol. in H_2O or $HCl+Aq$. Sol. in HNO_3+Aq.

Insol. in cold, slowly decomp. by hot alkalies $+Aq$. (Hahn, J. pr. (2) **93.** 436.)

$2PbSe$, P_2Se_3. Insol. in H_2O, HCl, or HNO_3+Aq. Slowly sol. in red fuming HNO_3. (Hahn.)

$2PbSe$, P_2Se_5. Decomp. by fuming HNO_3. (Hahn.)

Lead selenide, PbSe.

Cold HNO_3+Aq dissolves Pb with separation of Se, which dissolves on warming. (Little, A. **112**. 212.)

Min. *Clausthalite*. Sol. in HNO_3+Aq with separation of Se, when warmed.

Lead mercury selenide, (Pb, Hg)Se.

Min. *Lehrbachite*.

Lead sulphide, PbS.

Insol. in H_2O, dilute acids, alkalies, and alkali sulphides+Aq. Decomp. with solution in moderately dil. HNO_3+Aq. With conc. HNO_3 or aqua regia, $PbSO_4$ is formed. Sol. in hot conc. HCl+Aq.

Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Somewhat sol. in H_2S+Aq when heated therewith in a sealed tube. (Senarmont, A. ch. (3) **32**. 168.)

Insol. in potassium thiocarbonate +Aq. (Rosenbladt, Z. anal. **26**. 15.)

Sol. in $Na_2S_2O_3$+Aq. (Waller, J. Anal. Ch. **5**. 646.)

Min. *Galena*, *Galenite*.

Lead platinum sulphide.

See **Sulphoplatinate, lead.**

Lead sulphide mercuric chloride, 3PbS, $4HgCl_2$.

Decomp. by H_2O. (Levallois, C. R. **96**. 1666.)

Lead sulphobromide, chloride, or iodide.

See **Lead bromosulphide,** etc.

Lead telluride, PbTe.

Insol. in H_2O. Sol. in cold HNO_3+Aq. (Rose, Pogg. **18**. 68.)

Min. *Altaite*. Easily sol. in HNO_3+Aq.

" Leucone."

Wöhler (A. **127**. 268) gives this substance the formula $H_{10}Si_8O_{10}$, but it is identical with silicoformic anhydride, $Si_2H_2O_3$, which see.

Lime.

Quicklime, CaO. *See* **Calcium oxide.**

Slaked lime, CaO_2H_2. *See* **Calcium hydroxide.**

Lithium, Li.

Decomposes H_2O.

Easily sol. in dil. acids. Slowly attacked by conc. H_2SO_4, rapidly by conc. HNO_3+Aq.

Insol. in hydrocarbons. Sol. in liquid NH_3, but not so easily as K.

Lithium bromide, LiBr.

Deliquescent.

100 pts. H_2O dissolve at:

0°	34°	59°	82°	103°	
143	196	222	244	270	pts. LiBr.

Sp. gr. of LiBr+Aq at 19·5° containing:

5	10	15	20	25	30	% LiBr,
1·035	1·072	1·113	1·156	1·204	1·254	

35	40	45	50	55	% LiBr.
1·309	1·368	1·432	1·500	1·580	

(Kremers, Pogg. **103**. 65; **104**. 133: Gerlach, Z. anal. **8**. 285.)

Lithium chloride, LiCl.

Very deliquescent. Most deliquescent salt known to Berzelius. Very sol. in H_2O. Sol. in 1·315 pts. H_2O at 15°. (Gerlach.)

100 pts. H_2O dissolve at:

0°	20°	65°	80°	96°	140°	160°	
63·7	80·7	104·2	115	129	139	145	pts. LiCl.

Sp. gr. of LiCl+Aq at 15° containing:

1	5	10	15	20	% LiCl,
1·006	1·030	1·058	1·086	1·117	

25	30	35	40	% LiCl.
1·148	1·182	1·219	1·256	

(Gerlach, Z. anal. **8**. 281.)

Sp. gr. of LiCl+Aq at 18° containing:

5	10	20	30	40	% LiCl.
1·0274	1·0563	1·115	1·181	1·255	

(Kohlrausch, W. Ann. **1879**. 1.)

Sat. LiCl+Aq boils at 171°. (Kremers.)

B.-pt. of LiCl+Aq. P=pts. LiCl to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	3·5	124°	48·5	147°	87·5
102	7	125	50	148	90
103	10	126	51·5	149	92·5
104	12·5	127	53	150	95
105	15	128	54·5	151	97·5
106	17·5	129	56	152	100
107	20	130	57·5	153	102·5
108	22	131	59	154	105
109	24	132	60·5	155	107·5
110	26	133	62	156	110·5
111	28	134	63·5	157	113·5
112	30	135	65	158	116·5
113	32	136	66·5	158·5	117·96
114	33·5	137	68	159	119·5
115	35	138	69·75	160	122·5
116	36·5	139	71·5	161	125·5
117	38	140	73·25	162	128·5
118	39·5	141	75	163	131·5
119	41	142	77	164	135
120	42·5	143	79	165	138·5
121	44	144	81	166	142·5
122	45·5	145	83	167	146·5
123	47	146	85	168	151

(Gerlach, Z. anal. **26**. 437.)

B.-pt. of LiCl+Aq.

% LiCl	B.-pt.	% LiCl	B.-pt.
3·38	101°	16·66	107°
6·54	102	19·35	109
13·04	105	21·8	111

(Skinner, Chem. Soc. **61**. 341.)

B.-pt. of alcoholic solution of LiCl.

% LiCl	B.-pt.	% LiCl	B.-pt.
2·4	78·43°+0·70°	9·93	78·43°+ 5·55°
5·39	,, +2·15	15·94	,, +11·75
8·01	,, +4·18	...	...

(Skinner.)

Sol. in absolute alcohol, ether, and alcohol-ether.

Sol. in 15 pts. fusel oil. (Gooch, Am. Ch. J. **9**. 33.)

$+2H_2O$. Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6**. 184.)

Lithium manganous chloride, $LiCl, MnCl_2+3H_2O$.

Decomp. by H_2O; stable only in excess of LiCl. (Chassevant, A. ch. (6) **30**. 10.)

Lithium mercuric chloride.

(*a*) Not deliquescent.
(*b*) Deliquescent. (v. Bonsdorff.)

Lithium nickel chloride, $LiCl, NiCl_2+3H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Chassevant.)

Lithium stannic chloride.

See **Chlorostannate, lithium.**

Lithium chloroiodide, $LiCl_4I+4H_2O$.

Deliquescent. (Wells and Wheeler, Sill. Am. J. **144**. 42.)

Lithium fluoride, LiF.

Very difficultly sol. in H_2O. (Berzelius, Pogg. **1**. 17.)

Lithium hydrogen fluoride, $LiHF_2$.

Difficultly sol. in H_2O, but more easily than LiF. (Berzelius.)

Lithium stannic fluoride.

See **Fluostannate, lithium.**

Lithium uranyl fluoride, UO_2F_2, 4LiF. (Ditte.)

Lithium hydrosulphide, LiSH (?).

Deliquescent. Sol. in H_2O and alcohol. (Berzelius, Pogg. **6**. 439.)

Lithium hydroxide, LiOH.

Not so deliquescent as NaOH, and apparently not more sol. in hot than cold H_2O. (Gmelin, Gilb. **62**. 399.)

Not deliquescent. (Arfvedson, A. ch. **10**. 82.)

The solubility of LiOH in H_2O can be expressed by $y=6{\cdot}6750+0{\cdot}00346t+0{\cdot}0003t^2$, where y = the percentage of Li_2O in a saturated solution. (Dittmar, Jour. Soc. Chem. Ind. **7**. 730.)

Sp. gr. of LiOH + Aq at 18° containing:

1·25	2·5	5	7·5 % LiOH.
1·0132	1·0276	1·0547	1·0804

(Kohlrausch, W. Ann. **1879**. 1.)

Sl. sol. in alcohol; insol. in alcohol-ether. (Mayer.)

Cryst. also with H_2O, and $\frac{1}{2}H_2O$. (Göttig, B. **20**. 2912.)

Lithium iodide, LiI.

Deliquescent.

Solubility in 100 pts. H_2O at:

0°	19°	40°	59°	75°	80°	99°	120°
151	164	179	200	263	435	476	588 pts. LiI.

Sp. gr. of LiI + Aq at 19·5° containing:

5	10	15	20	25	30 % LiI,
1·038	1·079	1·124	1·172	1·224	1·280
35	40	45	50	55	60 % LiI.
1·344	1·414	1·489	1·575	1·670	1·777

(Kremers, Pogg. **104**. 133; **111**. 60: Gerlach, Z. anal. **8**. 295.)

Sp. gr. of LiI + Aq at 18° containing:

5	10	15	20	25 % LiI.
1·0361	1·0756	1·1180	1·1643	1·2138

(Kohlrausch, W. Ann. **1879**. 1.)

$+3H_2O$. (Rammelsberg.)

Lithium nitride, Li_3N.

Sol. in H_2O with decomp. (Ouvrard, C. R. **114**. 120.)

Lithium oxide, Li_2O.

Slowly sol. in H_2O to form LiOH.

See **Lithium hydroxide.**

Lithium selenide, Li_2Se.

Sol. in H_2O. (Fabre, C. R. **103**. 269.)

$+9H_2O$. Sol. in H_2O. (Fabre.)

Lithium *mono*sulphide, Li_2S.

More sol. in H_2O or alcohol than LiOH.

Luteochromium bromide, $Cr(NH_3)_6Br_3$.

Less sol. in H_2O than the chloride. (Jörgensen, J. pr. (2) **30**. 1.)

—— **bromoplatinate**, $[Cr(NH_3)_6]_2(PtBr_6)_3+4H_2O$.

Sl. sol. in H_2O. Insol. in alcohol. (Jörgensen.)

—— **chloride**, $Cr(NH_3)_6Cl_3+H_2O$.

Efflorescent, and very sol. in H_2O. (Jörgensen.)

—— **chloroplatinate.**

(*a*) $[Cr(NH_3)_6]_2(PtCl_6)_3+6H_2O$. Nearly completely insol. in H_2O. (Jörgensen.)

(*b*) $Cr(NH_3)_6Cl(PtCl_6)+2\frac{1}{2}H_2O$. Decomp. by H_2O into above; insol. in alcohol. (Jörgensen.)

(*c*) $[Cr(NH_3)_6]_2Cl_4(PtCl_6)+2H_2O$. Decomp. by H_2O into (*a*). (Jörgensen.)

—— **mercuric chloride**, $Cr(NH_3)_6Cl_3$, $HgCl_2$.

Decomp. by H_2O; sl. sol. in dil. HCl + Aq; insol. in alcohol.

$Cr(NH_3)_6Cl_3$, $3HgCl_2+2H_2O$. Decomp. by dil. HCl + Aq into above salt. (Jörgensen.)

—— **chromicyanide**, $Cr(NH_3)_6Cr(CN)_6$.

Precipitate.

—— **cobalticyanide**, $Cr(NH_3)_6Co(CN)_6$.

Nearly insol. in H_2O or in conc. HCl + Aq. (Jörgensen.)

—— **ferrocyanide**, $Cr(NH_3)_6Fe(CN)_6$.

Very sl. sol. in cold H_2O or dil. acids. (Jörgensen.)

—— **iodide**, $Cr(NH_3)_6I_3$.

Sl. sol. in H_2O. (Jörgensen, *l.c.*)

—— **iodosulphate**, $Cr(NH_3)_6SO_4I$.

Sol. in H_2O; nearly insol. in dil. NH_4OH + Aq or alcohol. (Jörgensen.)

Luteochromium nitrate, $Cr(NH_3)_6(NO_3)_3$.

Sol. in 35-40 pts. H_2O. Insol. in cold dil. HNO_3+Aq or alcohol. Can be crystallised out of H_2O containing a little HNO_3. (Jörgensen, J. pr. (2) **30.** 1.)

—— **nitrate chloroplatinate,** $Cr(NH_3)_6(NO_3)PtCl_6+H_2O$.

Insol. in H_2O. Sol. in dil. H_2SO_4+Aq. (Jörgensen.)

—— **nitratosulphate,** $Cr(NH_3)_6(NO_3)SO_4$.

Sol. in H_2O; insol. in alcohol. (Jörgensen.)

—— **oxalate,** $[Cr(NH_3)_6]_2(C_2O_4)_3+4H_2O$.

Nearly insol. in cold H_2O. (Jörgensen.)

—— *ortho***phosphate,** $Cr(NH_3)_6PO_4+4H_2O$.

Sl. sol. in H_2O; easily sol. in dil. acids. (Jörgensen.)

—— **sodium** *pyro***phosphate,** $Cr(NH_3)_6(NaP_2O_7)+11\frac{1}{2}H_2O$.

Nearly insol. in cold H_2O; wholly insol. in dil. NH_4OH+Aq. (Jörgensen.)

—— **sulphate,** $[Cr(NH_3)_6]_2(SO_4)_3+5H_2O$.

Quite sol. in H_2O; insol. in alcohol. (Jörgensen.)

—— **sulphate chloroplatinate,** $[Cr(NH_3)_6(SO_4)]_2PtCl_6$.

Nearly insol. in H_2O. (Jörgensen.)

Luteocobalt ***di*****amine chromium sulphocyanide.**

See **Diamine chromium luteocobalt sulphocyanide.**

Luteocobaltic bromide, $Co(NH_3)_6Br_3$.

Sol. in H_2O. Precipitated from saturated H_2O solution by dil. $HBr+Aq$. (Jörgensen, J. pr. (2) **35.** 417.)

—— **bromopermanganate,** $Co(NH_3)_6Br_2(MnO_4)$.

Easily sol. in H_2O. (Klobb, A. ch. (6) **12.** 5.)

—— **bromoplatinate,** $Co(NH_3)_6Br_3$, $PtBr_4+H_2O$.

Sl. sol. in H_2O; can be recrystallised from hot H_2O containing HBr. (Jörgensen.)

—— **bromosulphate,** $Co(NH_3)_6Br(SO_4)$.

Nearly insol. in H_2O. Very sl. sol. in dil. NH_4OH+Aq. (Jörgensen.)

—— **carbonate,** $[Co(NH_3)_6]_2(CO_3)_3+7H_2O$.

Efflorescent; easily sol. in H_2O.

$[Co(NH_3)_6]_2(CO_3)_3$, $H_2CO_3+5H_2O$. Less sol. in H_2O than the neutral salt. (Gibbs and Genth.)

—— **chloride,** $Co(NH_3)_6Cl_3$.

Sol. in 17·09 pts. H_2O at 10·5°; 16·81 pts. at 11·4°; 16·48 pts. at 12°; and more easily in hot H_2O. (F. Rose.)

100 pts. H_2O dissolve 4·26 pts. at 0°, and 12·74 pts. at 46·6°. (Kurnakoff, J. russ. Soc. **24.** 629.)

Not appreciably sol. in conc. $HCl+Aq$. (Jörgensen.)

Insol. in alcohol or solutions of the alkali chlorides. (Gibbs and Genth.)

Insol. in NH_4OH+Aq.

Aqueous solution is pptd. by alcohol, mineral acids, or alkali chlorides.

Luteocobaltic mercuric chloride, $Co(NH_3)_6Cl_3$, $HgCl_2+1\frac{1}{2}H_2O$.

Sol. in hot H_2O. (Krok, **1870.**)

By recrystallising from hot H_2O containing HCl is converted into—

$Co(NH_3)_6Cl_3$, $3HgCl_2+H_2O$. Very sl. sol. in cold H_2O. (Jörgensen.)

$Co(NH_3)_6Cl_3$, $2HgCl_2+\frac{1}{2}H_2O$. Sol. in hot H_2O, from which it crystallises on cooling. Insol. in cold conc. $HCl+Aq$, and is pptd. from H_2O solution by HCl or alcohol. (Carstanjen.)

Does not exist. (Jörgensen.)

$+3H_2O$. More easily sol. in cold H_2O and other solvents than the preceding comp. (Carstanjen, Berlin, **1861.**)

Does not exist. (Jörgensen.)

—— **stannous chloride,** $2Co(NH_3)_6Cl_3$, $3SnCl_2+10H_2O$.

$+8H_2O$.

—— **chloraurate,** $Co(NH_3)_6Cl_3$, $AuCl_3$.

Very sl. sol. in cold, more easily in hot H_2O containing HCl. (Gibbs and Genth, Sill. Am. J. (2) **23.** 330.)

—— **chloriodate,** $[Co(NH_3)_6Cl_2]_2I_4O_{11}+H_2O$.

—— **chloriridite,** $Co(NH_3)_6$, $IrCl_6$.

Insol. in boiling H_2O or dil. $HCl+Aq$. (Gibbs.)

—— **chloriridate,** $2Co(NH_3)_6Cl_3$, $3IrCl_4$.

Insol. in H_2O. (Gibbs.)

—— **chloropalladite,** $2Co(NH_3)_6Cl_3$, $3PdCl_2$.

Easily sol. in dil. $HCl+Aq$. (Gibbs, Sill. Am. J. (2) **37.** 58.)

—— **chloropermanganate,** $Co(NH_3)_6Cl_2(MnO_4)$.

Can be recrystallised from H_2O. (Klobb, C. R. **103.** 384.)

—— **chloropermanganate ammonium chloride,** $Co(NH_3)_6Cl_2(MnO_4)$, NH_4Cl.

Easily sol. in H_2O. (Klobb.)

—— **chloropermanganate potassium chloride,** $Co(NH_3)_6Cl_2(MnO_4)$, KCl.

Very easily sol. in H_2O, with decomp. into constituents; sol. in $KCl+Aq$. (Klobb.)

—— **chloropermanganate sodium chloride,** $Co(NH_3)_6Cl_2(MnO_4)$, NaCl.

Very sol. in H_2O. (Klobb.)

—— **chloroplatinate,** $2Co(NH_3)_6Cl_3$, $3PtCl_4+6H_2O$.

Can be recrystallised from much hot H_2O. (Gibbs and Genth.)

$+21H_2O$. (Gibbs and Genth.)

$Co(NH_3)_6Cl_3$, $PtCl_4+\frac{1}{2}H_2O$. Very sl. sol. in cold, decomp. by hot H_2O into—

$2Co(NH_3)_6Cl_3$, $PtCl_4+2H_2O$. By recrystallising from hot H_2O containing HCl this salt is converted into the above salt. (Jörgensen.)

Luteocobaltic chlororhodite.

Nearly insol. in boiling H_2O or dil. acids. Sol. in conc. $HCl+Aq$. (Gibbs, Sill. Am. J. (2) **37.** 57.)

—— **chlororuthenate,** $2Co(NH_3)_6Cl_3, 3RuCl_4$.

Sol. in dil. acids. (Gibbs.)

—— **chlorosulphate,** $Co(NH_3)_6Cl(SO_4)$.

Sol. in H_2O.

—— **chlorosulphate chloroplatinate,** $2Co(NH_3)_6Cl(SO_4), PtCl_4$.

Very sl. sol. in cold pure H_2O. Can be recrystallised out of H_2O containing HCl. (Krok.)

—— **chlorosulphate mercuric chloride,** $Co(NH_3)_6Cl(SO_4), HgCl_2$.

Scarcely sol. in pure H_2O, but can be crystallised from warm acidified H_2O. (Krok.)

—— **chlorosulphite,** $Co(NH_3)_6(SO_3)Cl+3H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2637.)

—— **chromate,** $[Co(NH_3)_6]_2(CrO_4)_3+5H_2O$.

Ppt. Sol. in hot H_2O.

$[Co(NH_3)_6]_2(Cr_2O_7)_3+5H_2O$. Moderately sol. in hot H_2O.

—— **chromicyanide,** $Co(NH_3)_6Cr(CN)_6$.

Ppt. (Braun.)

—— **cobalticyanide,** $Co(NH_3)_6Co(CN)_6$.

Ppt.

—— **dithionate, basic,** $4[Co(NH_3)_6(S_2O_6)(OH)], Co_2(S_2O_6)_2O$.

Sol. in H_2O and dil. alcohol.

—— **ferricyanide,** $Co(NH_3)_6Fe(CN)_6+\frac{1}{2}H_2O$.

Insol. in H_2O. (Braun.)

—— **hydroxide,** $Co(NH_3)_6(OH)_3$.

Known only in aqueous solution.

—— **mercuric hydroxychloride,** $CoN_6H_{14}(HgCl)_3(HgOH)Cl_3$.

Ppt. Easily decomp. (Vortmann and Morgulis, B. **22.** 2644.)

$CoN_6H_{14}(HgOH)_4Cl_3$. Ppt. (V. and M.)

$CoN_6H_{16}(HgOH)_2Cl_3$. Ppt. (V. and M.)

—— **iodide,** $Co(NH_3)_6I_3$.

Insol. in cold, but moderately sol. in hot H_2O.

According to Jörgensen, contains HNO_3 and has the formula $Co_2(NH_3)_{12}I_4(NO_3)_2$.

—— **iodosulphate,** $Co(NH_3)_6I(SO_4)$.

Can be recrystallised from hot H_2O. Sl. sol. in warm, nearly insol. in cold H_2O. (Krok, B. **4.** 711.)

—— **mercuriodide,** $Co_2N_{12}H_{33}(HgI)_3I_6$.

Ppt. (Vortmann and Borsbach.)

$CoN_6H_{16}(HgI)_2I_3$. Ppt. (V. and B.)

—— **mercuriodide, basic,** $CoN_6H_{16}(HgOH)_2I_2(OH)$.

Insol. in H_2O. Sl. sol. in H_2O. (Vortmann and Borsbach, B. **23.** 2804.)

Luteocobaltic nitrate, $Co(NH_3)_6(NO_3)_3$.

Sol. in H_2O. Can be recrystallised from boiling H_2O. Sol. in about 60 pts. H_2O. Insol. in conc. HNO_3+Aq. (Jörgensen, J. pr. (2) **35.** 417.)

Almost insol. in acids. (Rogojski, A. ch. (3) **41.** 454.)

Insol. in NH_4OH, HCl, and HNO_3+Aq; decomp. by H_2SO_4+Aq. (Gibbs and Genth.)

$Co(NH_3)_6(NO_3)_3, HNO_3$. Decomp. by H_2O or dil. alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— **nitrate chloroplatinate,** $Co(NH_3)_6(NO_3)Cl_2, PtCl_4+H_2O$.

Not decomp. by H_2O. (Jörgensen.)

—— **nitratosulphate,** $Co(NH_3)_6(NO_3)(SO_4)$.

Sol. in H_2O. (Jörgensen.)

—— **nitrite cobaltic nitrite,** $Co_2(NH_3)_{12}(NO_2)_6, Co_2(NO_2)_6 = Co(NH_3)_6(NO_2)_6Co$.

Nearly insol. in H_2O. (Jörgensen.)

Much less sol. in H_2O than the corresponding roseo salt. (Gibbs.)

—— **diamine cobaltic nitrite,** $Co(NH_3)_6[Co(NH_3)_2(NO_2)_4]_3$.

Ppt. (Gibbs.)

$=Co(NH_3)_6[(NO_2)_2(NH_3)_2Co(NO_2)_2]_3$. Nearly insol. in cold, sl. sol. in boiling H_2O. (Jörgensen, Z. anorg. **5.** 179.)

—— **oxalate,** $[Co(NH_3)_6]_2(C_2O_4)_3+4H_2O$.

Insol. in hot or cold H_2O. Easily sol. in $H_2C_2O_4+Aq$.

—— **oxalate chloraurate,** $2Co(NH_3)_6(C_2O_4)Cl, AuCl_3+4H_2O$.

Easily sol. in hot H_2O. (Gibbs.)

—— **permanganate,** $[Co(NH_3)_6]_2(MnO_4)_3$.

Nearly insol. in H_2O. 100 pts. H_2O at 0° dissolve only 0·072 pt. salt. Moderately sol. in hot H_2O. (Klobb, A. ch. (6) **12.** 5.)

—— *ortho***phosphate,** $Co(NH_3)_6(PO_4)+4H_2O$.

Sl. sol. in cold H_2O. Easily sol. in dil. acids. (Jörgensen.)

$[Co(NH_3)_6]_3(PO_4)(PO_4H)_3+5\frac{1}{2}H_2O$ (?). Ppt. (Braun.)

$[Co(NH_3)_6]_2(PO_4H)_3+4H_2O$. Ppt. Easily sol. in very dil. $HCl+Aq$. (Jörgensen.)

—— *meta***phosphate.**

Ppt.

—— *pyro***phosphate,** $[Co(NH_3)_6]_2P_4O_{13}+6H_2O$ (Gibbs, Am. Acad. Proc. **11.** 29); or $Co_2(NH_3)_{12}P_4O_{13}(ONa)_2$ (Vortmann, B. **11.** 2181); or $Co(NH_3)_6(P_2O_7Na)+11\frac{1}{2}H_2O$. (Jörgensen, J. pr. (2) **35.** 438.)

Very nearly insol. in H_2O. With H_2O at 80° it is decomp. into—

$[Co(NH_3)_6]_4(P_2O_7)_3+20H_2O$. Less easily sol. than the preceding salt.

—— *pyro***phosphate, acid,** $Co(NH_3)_6(P_2O_7H)$.

Wholly insol. in H_2O. Somewhat sol. in dil. $HC_2H_3O_2+Aq$. Easily sol. in $HCl+Aq$. (Jörgensen.)

Luteocobaltic sodium *pyro*phosphate, $Co(NH_3)_6(P_2O_7Na)+11\frac{1}{2}H_2O$.

Ppt. Not wholly insol. in cold H_2O. Decomp. by hot H_2O. Less sol. in NH_4OH+Aq than in H_2O. (Jörgensen.)

$[Co(NH_3)_6]_4(P_2O_7)_3$, $2Co(NH_3)_6(NaP_2O_7)+39H_2O$. As above. (Jörgensen.)

—— **sulphate,** $[Co(NH_3)_6]_2(SO_4)_3+5H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

$+6H_2O$. (Krok, B. **4.** 711.)

—— **cerium sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $Ce_2(SO_4)_3+1\frac{1}{2}H_2O$.

Very sl. sol. in cold, and practically insol. in boiling H_2O. Sol. in acids. (Gibbs, Am. Ch. J. **15.** 560.)

$[Co(NH_3)_6]_2(SO_4)_3$, $3Ce(SO_4)_2+H_2O$. As above. (Wing, Sill. Am. J. (2) **49.** 363.)

—— **lanthanum sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $La_2(SO_4)_3+H_2O$.

Sl. sol. in H_2O. (Wing.)

—— **thallic sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $Tl_2O(SO_4)_2+5H_2O$.

Decomp. by cold H_2O. (Gibbs.)

—— **sulphate bromaurate,** $Co(NH_3)_6(SO_4)(AuBr_4)$.

Very sl. sol. in H_2O with apparent decomp. Insol. in alcohol. (Jörgensen.)

—— **sulphate chloraurate,** $Co(NH_3)_6(SO_4)AuCl_4$.

Sl. sol. in H_2O. (Jörgensen.)

—— **cobaltic sulphite,** $[Co(NH_3)_6]_2(SO_3)_3$, $Co_2(SO_3)_3+H_2O$ = **dichrocobaltic sulphite,** $[Co(NH_3)_3]_2(SO_3)_3+2H_2O$, which see.

$[Co(NH_3)_6]_2(SO_3)_3$, $2Co_2(SO_3)_3+15H_2O$ = **diamine cobaltic sulphite,** $[Co(NH_3)_2]_2(SO_3)_3+5H_2O$, which see.

Luteorhodium bromide, $Rh(NH_3)_6Br_3$.

Less sol. in H_2O than the chloride. (Jörgensen, J. pr. (2) **44.** 51.)

—— **chloride,** $Rh(NH_3)_6Cl_3$.

Sol. in 7 to 8 pts. H_2O at 8°. (J.)

$+H_2O$. Extremely efflorescent. (J.)

—— **rhodium chloride,** $Rh(NH_3)_6Cl_3$, $RhCl_3$.

Sol. in H_2O. (Jörgensen, Z. anorg. **5.** 174.)

—— **chloroplatinate,** $2Rh(NH_3)_6Cl_3$, $3PtCl_4+6H_2O$.

Insol. in H_2O. Sol. in warm HCl+Aq. (J.)

$Rh(NH_3)_6Cl_3$, $PtCl_4+\frac{1}{2}H_2O$. Decomp. by H_2O into chloride and above salt. (J.)

—— **nitrate,** $Rh(NH_3)_6(NO_3)_3$.

Sol. in 48 to 49 pts. H_2O at ord. temp. HNO_3+Aq diluted with 5 vols. H_2O ppts. the salt completely from aqueous solution. (Jörgensen, J. pr. (2) **44.** 51.)

$Rh(NH_3)_6(NO_3)_3$, HNO_3. Decomp. by H_2O or dil. alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— ***ortho*phosphate,** $Rh(NH_3)_6PO_4+4H_2O$.

Sl. sol. in cold H_2O. (J.)

Luteorhodium sodium *pyro*phosphate, $[Rh(NH_3)_6]_2(P_2O_7)_3Na_2+23H_2O$.

Nearly wholly insol. in H_2O. Wholly insol. in NH_4OH+Aq. (J.)

—— **sulphate,** $[Rh(NH_3)_6]_2(SO_4)_3+5H_2O$.

Sol. in 43 pts. H_2O at 20°. (J.)

Magnesium, Mg.

Does not decomp. H_2O at ord. temp., but decomp. slowly at 100°. H_2O containing acids dissolves Mg easily. Sol. in cold dil. $HC_2H_3O_2$+Aq. Difficultly sol. in cold H_2SO_4+Aq. (Bunsen.) Cold nitrosulphuric acid does not attack. (Bunsen.) Cold NH_4OH+Aq, KOH+Aq, or NaOH+Aq do not attack. (Maack, Phippson.) Sol. in NH_4Cl, or $(NH_4)_2CO_3$+Aq. (Wöhler.)

Magnesium arsenide, Mg_3As_2.

Decomp. on air. (Parkinson, Chem. Soc. **5.** 127.)

Magnesium boride, Mg_9B_2.

Sol. in HCl+Aq. (Winkler, B. **23.** 774.)

Magnesium bromide, $MgBr_2+6H_2O$.

Deliquescent. Very sol. in H_2O with evolution of heat.

Sp. gr. of $MgBr_2$+Aq at 19·5° containing:

5	10	15	20	25 % $MgBr_2$,
1·043	1·087	1·137	1·191	1·247
30	35	40	45	50 % $MgBr_2$.
1·31	1·377	1·451	1·535	1·625

(Kremers, Pogg. **108.** 118, calculated by Gerlach, Z. anal. **8.** 285.)

$MgBr_2$+Aq is sl. decomp. by evaporation. Sol. in alcohol.

Magnesium manganous bromide, $MgBr_2$, $2MnBr_2+12H_2O$.

Deliquescent. (Saunders, Am. Ch. J. **14.** 150.)

Magnesium mercuric bromide, $MgBr_2$, $HgBr_2$.

Deliquescent.

$MgBr_2$, $2HgBr_2$. Not deliquescent.

Magnesium potassium bromide, $MgBr_2$, $2KBr+6H_2O$.

Easily sol. in H_2O, from which KBr crystallises at 75 to 87°. Alcohol dissolves out $MgBr_2$. (Löwig, Repert. **29.** 261.)

Formula is $MgBr_2$, $KBr+6H_2O$. Deliquescent. (Lerch, J. pr. (2) **28.** 338.)

Magnesium stannic bromide.

See **Bromostannate, magnesium.**

Magnesium chloride, $MgCl_2$.

Deliquescent. Very sol. in H_2O with evolution of heat. The solution decomposes on evaporation losing HCl, when less than 6 mols. H_2O are present to 1 mol. $MgCl_2$. (Casaseca, C. R. **37.** 350.)

Anhydrous. Sol. in 1·857 pts. H_2O at 15°. (Gerlach.)

Sol. in 1 pt. cold H_2O. (Fourcroy.)

Sat. $MgCl_2$+Aq at 12·5° contains 64·8 % $MgCl_2$. (Hassenfratz.)

100 pts. H_2O at 15·5° dissolve 200 pts. $MgCl_2$. (Ure's Dict.)

100 pts. H_2O dissolve 52·2 pts. $MgCl_2$ at 0° and sp. gr. of sat. solution = 1·3619 at 15°. (Engel, Bull. Soc. (2) **47**. 318.)

+6H_2O. Deliquescent. Sol. in 0·6 pt. cold, and 0·273 pt. hot H_2O. (Casaseca, *l.c.*)

Sp. gr. of $MgCl_2$+Aq at 19·5°.

Pts. $MgCl_2$ in 100 pts. H_2O	Sp. gr.	Pts. $MgCl_2$ in 100 pts. H_2O	Sp. gr.
10·7	1·0826	35·3	1·2388
22·0	1·1592	51·5	1·3235

(Kremers, Pogg. **104**. 155.)

Sp. gr. of $MgCl_2$+Aq at 14°.

% $MgCl_2$ +6H_2O	Sp. gr.	% $MgCl_2$ +6H_2O	Sp. gr.	% $MgCl_2$ +6H_2O	Sp. gr.
0	0·9993	17	1·0682	34	1·1407
1	1·0033	18	1·0724	35	1·1451
2	1·0073	19	1·0765	36	1·1495
3	1·0113	20	1·0807	37	1·1540
4	1·0154	21	1·0849	38	1·1584
5	1·0194	22	1·0891	39	1·1628
6	1·0234	23	1·0933	40	1·1673
7	1·0274	24	1·0976	41	1·1718
8	1·0314	25	1·1018	42	1·1763
9	1·0355	26	1·1061	43	1·1809
10	1·0395	27	1·1103	44	1·1855
11	1·0435	28	1·1146	45	1·1901
12	1·0476	29	1·1189	46	1·1948
13	1·0517	30	1·1232	47	1·1995
14	1·0558	31	1·1275	48	1·2042
15	1·0599	32	1·1319	...	...
16	1·0641	33	1·1363	...	...

(Oudemans, Z. anal. **7**. 420.)

Sp. gr. of $MgCl_2$+Aq at 24°.

% $MgCl_2$ +6H_2O	Sp. gr.	% $MgCl_2$ +6H_2O	Sp. gr.	% $MgCl_2$ +6H_2O	Sp. gr.
2	1·0069	30	1·1062	58	1·2167
4	1·0138	32	1·1137	60	1·2252
6	1·0207	34	1·1212	62	1·2338
8	1·0276	36	1·1288	64	1·2425
10	1·0345	38	1·1364	66	1·2513
12	1·0415	40	1·1441	68	1·2602
14	1·0485	42	1·1519	70	1·2692
16	1·0556	44	1·1598	72	1·2783
18	1·0627	46	1·1677	74	1·2875
20	1·0698	48	1·1756	76	1·2968
22	1·0770	50	1·1836	78	1·3063
24	1·0842	52	1·1918	80	1·3159
26	1·0915	54	1·2000	...	...
28	1·0988	56	1·2083	...	...

(Gerlach, Z. anal. **8**. 283. Calculated from Schiff.)

Sp. gr. of $MgCl_2$+Aq at 15°.

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
1	1·0084	13	1·1130	25	1·2274
2	1·0169	14	1·1220	26	1·2378
3	1·0253	15	1·1311	27	1·2482
4	1·0338	16	1·1404	28	1·2586
5	1·0422	17	1·1498	29	1·2690
6	1·0510	18	1·1592	30	1·2794
7	1·0597	19	1·1686	31	1·2903
8	1·0684	20	1·1780	32	1·3012
9	1·0772	21	1·1879	33	1·3121
10	1·0859	22	1·1977	34	1·3230
11	1·0949	23	1·2076	35	1·3340
12	1·1040	24	1·2175	...	...

(Gerlach, Z. anal. **8**. 281.)

Sp. gr. of $MgCl_2$+Aq at 18°.

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
5	1·0416	20	1·1764	34	1·3210
10	1·0859	30	1·2779	...	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $MgCl_2$+Aq at 0°. S=pts. salt in 100 pts. of solution; S_1=mols. salt in 100 mols. solution.

S	S_1	Sp. gr.
29·2056	7·230	1·2788
20·9293	4·762	1·1927
15·7989	3·423	1·1427
11·3249	2·355	1·1007
6·2008	1·233	1·0545

(Charpy, A. ch. (6) **29**. 23.)

$MgCl_2$+Aq containing 10 % $MgCl_2$ boils at 101·6°; containing 20 % $MgCl_2$ boils at 106·2°; containing 30 % $MgCl_2$ boils at 115·6°. (Gerlach.)

Sat. $MgCl_2$+Aq forms a crust at 122·5°, and contains 52·9 pts. $MgCl_2$ to 100 pts. H_2O. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of $MgCl_2$+Aq. P=pts. $MgCl_2$ to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	4·9	111°	34·6	121°	50·8
102	9·2	112	36·6	122	52·2
103	13·2	113	38·4	123	53·6
104	16·7	114	40·2	124	55·0
105	19·9	115	41·8	125	56·4
106	22·5	116	43·4	126	57·7
107	25·0	117	44·9	127	59·0
108	27·5	118	46·4	128	60·3
109	29·9	119	47·9	129	61·6
110	32·3	120	49·4	130	62·9

(Gerlach, Z. anal. **26**. 440.)

B.-pt. of $MgCl_2$+Aq containing % $MgCl_2$.

% $MgCl_2$	B.-pt.	% $MgCl_2$	B.-pt.
4·6	101°	11·6	103°
8·4	102	14·3	104

(Skinner, Chem. Soc. **61**. 341.)

Sol. in 7 pts. alcohol at 15°. (Bergmann.)
" 5 " " moderate heat. (B.)

100 pts. alcohol of given sp. gr. dissolve pts. $MgCl_2$:

Sp. gr.	Pts. $MgCl_2$	Sp. gr.	Pts. $MgCl_2$
0·900	21·25	0·834	36·25
0·848	23·75	0·817	50·00

(Kirwan.)

$MgCl_2+6H_2O$ is sol. in 5 pts. alcohol of 0·90 sp. gr. and in 2 pts. alcohol of 0·817 sp. gr.

Sol. in 0·1828 pt. strong alcohol at 82·5°. (Wenzel.)

B.-pt. of an alcoholic solution of $MgCl_2$.

% $MgCl_2$	B.-pt.
5·56	78·43°+0·73°
8·53	" +1·34
9·62	" +1·77
13·84	" +3·54

(Skinner, Chem. Soc. **61**. 341.)

Even more sol. in acetic ether than $CaCl_2$. (Cann, C. R. **102**. 363.)

Sol. in boiling amyl alcohol. (Riggs, Sill. Am. J. **144**. 103.)

Min. Bischofite.

Magnesium manganous chloride, $MgCl_2$, $2MnCl_2+12H_2O$.

Deliquescent. Very sol. in H_2O and alcohol. (Saunders, Am. Ch. J. **14**. 148.)

Magnesium mercuric chloride, $MgCl_2$, $HgCl_2+6H_2O$.

Very deliquescent. More sol. than the following salt. (v. Bonsdorff, Pogg. **17**. 133.)

$MgCl_2$, $3HgCl_2+5H_2O$. Sol. in H_2O without decomp. Easily sol. in alcohol. (v. Bonsdorff.)

Magnesium phosphoryl chloride, $MgCl_2$, $POCl_3$.

Deliquescent. Sol. in H_2O with evolution of heat and decomposition. Very sl. sol. in warm $POCl_3$. (Casselmann, A. **98**. 223.)

Magnesium potassium chloride, $MgCl_2$, $2KCl+6H_2O$.

Deliquescent, forming a solution of $MgCl_2$, while KCl remains undissolved. 100 pts. H_2O dissolve 64·5 pts. at 18·75°. 20 pts. salt dissolved in 80 pts. H_2O lower the temp. 1·75°. (Bischof.) Alcohol dissolves out $MgCl_2$. Decomp. into the two salts by solution in H_2O. (Marcet.)

Min. *Carnallite.*

Magnesium rubidium chloride, $MgCl_2$, $RbCl+6H_2O$.

Not decomp. by a small quantity of H_2O. (Feit and Kubierscky, Ch. Ztg. **16**. 335.)

Magnesium sodium chloride, $MgCl_2$, $NaCl+2H_2O$.

Sol. in H_2O. (Poggiale.)

Magnesium stannic chloride.

See **Chlorostannate, magnesium.**

Magnesium zinc chloride, $MgCl_2$, $ZnCl_2+6H_2O$.

Deliquescent; sol. in H_2O. (Warner, C. N. **27**. 271.)

Magnesium chloride ammonia, $MgCl_2$, $4NH_3$.

Easily decomp. (Clark, A. **78**. 369.)

Magnesium fluoride, MgF_2.

Insol. in H_2O. Scarcely sol. in acids. (Gay-Lussac and Thénard.) Insol. in excess of HF. When precipitated, is sol. in aqueous solution of ammonium and magnesium salts. Sol. in dil. HNO_3+Aq, from which it is precipitated by alcohol.

Min. *Sellaite.*

Magnesium sodium fluoride, MgF_2, NaF.

Insol. in H_2O. (Geuther, J. B. **1865**. 173.)

Magnesium stannic fluoride.

See **Fluostannate, magnesium.**

Magnesium titanium fluoride.

See **Fluotitanate, magnesium.**

Magnesium zirconium fluoride.

See **Fluozirconate, magnesium.**

Magnesium hydrosulphide, MgS_2H_2.

Known only in aqueous solution, which decomposes on warming. Solution containing 16 % MgS_2H_2 has sp. gr. 1·118 at 12°. (Divers and Shimidzu, Chem. Soc. **45**. 699.)

Magnesium hydroxide, MgO_2H_2.

MgO is sol. in 55,368 pts. H_2O at ordinary temp., and also at 100°. (Fresenius, A. **59**. 117.)

MgO is sol. in 5142 pts. H_2O at 15·5° (Fyfe); in 5800 pts. at 15·8° (Henry, J. Pharm. **13**. 2); in 7900 pts. (Kirwan); in 16,000 pts. (Dalton); in 100,000-200,000 pts. cold H_2O (Bineau); in 36,000 pts. boiling H_2O (Fyfe, Ed. Phil. J. **5**. 305.)

Calculated from electrical conductivity of MgO_2H_2+Aq, 1 l. H_2O dissolves 9 mg. MgO_2H_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Presence of CaO_2H_2 or $CaSO_4$ does not decrease the solubility. (Henry.) Presence of the salts of the alkali metals, especially ammonium salts, increase the solubility. Insol. in conc. Na_2SO_4, $NaNO_3$, NaCl, or KNO_3+Aq. (Karsten.) Sol. in NH_4OH+Aq, but insol. in KOH+Aq. (Odling.)

Easily sol. in acids. Sol. in an aqueous solution of sugar. Boiling alcohol dissolves traces.

See also **Magnesium oxide.**

Min. *Brucite.* Sol. in cold citric acid+Aq. (Bolton, C. N. **37**. 14.)

2MgO, $3H_2O$. (Bender, B. **3**. 932.)

Magnesium iodide, MgI_2.

Very deliquescent.

Sp. gr. of MgI_2+Aq at 19·5° containing:

5	10	15	20	25	30	% MgI_2,
1·043	1·088	1·139	1·194	1·254	1·32	
35	40	45	50	55	60	% MgI_2.
1·395	1·474	1·568	1·668	1·78	1·915	

(Kremers, Pogg. **111**. 62, calculated by Gerlach, Z. anal. **8**. 285.)

MgI_2+Aq decomp. slightly on evaporation.
Sol. in alcohol, ether, and wood-spirit.
+$8H_2O$.

Magnesium mercuric iodide, MgI_2, HgI_2.

Known only in solution.

MgI_2, $2HgI_2$. Decomp. by H_2O into HgI_2 and above compound, which remains in solution. (Boullay.)

Magnesium potassium iodide, MgI_2, KI + $6H_2O$.

Deliquescent. (Lerch, J. pr. (2) **28**. 338.)

Magnesium nitride, Mg_3N_2.

Decomp. by moist air or H_2O. Sol. in dil. or conc. HCl+Aq, or HNO_3+Aq. Sol. in warm H_2SO_4. Insol. in alcohol, ethyl iodide, or phosphorus oxychloride. (Briegleb and Geuther, A. **123**. 236.)

Magnesium *sub*oxide (?).

Decomp. H_2O. Sol. in dil. acids. (Beetz, Pogg. **127**. 45.)

Magnesium oxide, MgO.

Sol. in 50,000-100,000 pts. H_2O (Bineau, C. R. **41**. 510); in 55,368 pts. cold or hot H_2O (Fresenius, A. **59**. 123); in 100,000-200,000 pts. H_2O (Bunsen); in 16,000 pts. H_2O at ord. temp. (Dalton); in 7900 pts. H_2O at ord. temp. (Kirwan); in 5760 pts. H_2O at 15·5°, and 36,000 pts. at 100° (Fyfe).

Easily sol. in acids, even in H_2SO_3+Aq. Sol. in NH_4 salts, NaCl, or KCl+Aq. (Fresenius.)

More sol. in K_2SO_4, and Na_2SO_4+Aq than in H_2O. (Warrington.)

Solubility in (calcium sucrate + sugar) + Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 0·30 g. MgO; containing 296·5 g. sugar and 24·2 g. CaO dissolves 0·24 g. MgO; containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·22 g. MgO. (Bodenbender, J. B. **1865**. 600.)

See also **Magnesium hydroxide.**

Min. *Periclasite.*

Magnesium oxychloride, $Mg_2OCl_2+16H_2O$.

Easily decomp. by H_2O and alcohol. (André, A. ch. (6) **3**. 80.)

+$6H_2O$. (André.)

$Mg_6O_5Cl_2$+6, 8, 14, or $17H_2O$. Decomp. by H_2O, which dissolves out $MgCl_2$. (Bender, B. **3**. 932.)

$Mg_{11}O_{10}Cl_2$+14, or $18H_2O$. (Krause, A. **165**. 38.)

$Mg_{10}O_9Cl_2+24H_2O=9MgO, MgCl_2+24H_2O$. H_2O removes all $MgCl_2$ by long digesting. (Bender, A. **159**. 341.)

+10, and $15H_2O$. (Bender.)

Magnesium oxysulphide, Mg_2OS.

(Reichel, J. pr. (2) **12**. 55.)

Magnesium phosphide, Mg_3P_2.

Decomp. by H_2O, dil. HCl+Aq, or HNO_3+Aq. (Parkinson, Chem. Soc. (2) **5**. 125 and 309.)

Insol. in moderately dil. cold HCl+Aq, or boiling dil. H_2SO_4+Aq. Difficultly and slowly sol. in aqua regia. (Blunt, Chem. Soc. (2) **3**. 106.)

Magnesium silicide, Mg_5Si_3.

Slowly decomp. by warm H_2O. Slowly decomp. by cold, rapidly by hot NH_4Cl+Aq. Decomp. by cold dil. HCl+Aq. (Geuther, J. pr. **95**. 425.)

Mg_2Si. Decomp. by HCl+Aq with residue of Si. (Wöhler, A. **107**. 113.)

Magnesium sulphide, MgS.

Decomp. by H_2O. (Reichel, J. pr. (2) **12**. 55.)

Sl. sol. in H_2O with rapid decomp. (Fremy.)
Sol. in acids with decomp.

Magnesium *poly*sulphide, MgS_x.

Known only in solution. (Reichel.)

Magnus' green salt.

See **Plato*di*amine chloroplatinite.**

Manganese, Mn.

Decomposes H_2O even in the cold, more rapidly when hot. (Regnault.)

Decomposes cold water violently. (Bunsen.)

Sol. in all dil. acids. Slowly sol. in cold H_2SO_4. (John.)

Insol. in cold, but rapidly sol. in hot H_2SO_4. Very easily sol. in dil. H_2SO_4, or HCl+Aq, HNO_3, or $HC_2H_3O_2$+Aq. (Brunner.)

Pure manganese is unaltered in dry air, even when finely powdered. Slowly attacked by cold, quickly by hot H_2O. Very sl. attacked by cold H_2SO_4, rapidly on warming; rapidly attacked by cold dil. H_2SO_4+Aq; violently by conc. HNO_3+Aq; and rapidly by dil. HNO_3, HCl, $HC_2H_3O_2$+Aq, and also NaOH+Aq. Sol. in NH_4Cl+Aq. (Prelinger, W. A. B. **102, 2b**. 359.)

Manganese boride, MnB_2.

Sol. in acids, with evolution of H_2. (Troost and Hautefeuille, A. ch. (5) **9**. 65.)

Manganous bromide, $MnBr_2$.

Anhydrous. Very deliquescent.

+$4H_2O$. More deliquescent than $MnCl_2$. Melts in crystal water when heated. (Berthemot.)

Manganous mercuric bromide.

Deliquescent.

Manganous stannic bromide.

See **Bromostannate, manganous.**

Manganese carbide, MnC.

(Brown, J. pr. **17**. 492.)

MnC_2.

Mn_3C. (Troost and Hautefeuille, A. ch. (5) **9**. 60.)

Manganous chloride, $MnCl_2$.

Anhydrous. Deliquescent.

100 pts. H_2O at t° dissolve pts. $MnCl_2$:

t°	Pts. $MnCl_2$	t°	Pts. $MnCl_2$
10	62·16	87·5	122·22
31·25	85·72	106·25	123·81
62·5	122·22	...	...

or, sat. $MnCl_2+Aq$ at t° contains:

t°	% $MnCl_2$	t°	% $MnCl_2$
10	38·33	87·5	55·0
31·25	46·15	106·25	55·32
62·5	55·0	...	...

(Brandes, Pogg. **22.** 263.)

Sp. gr. of $MnCl_2+Aq$ at 15°. a=sp. gr. if % is $MnCl_2$; b=sp. gr. if % is $MnCl_2+4H_2O$.

%	a	b	%	a	b
5	1·045	1·0285	40	1·443	1·250
10	1·091	1·057	45	1·514	1·290
15	1·138	1·086	50	...	1·331
20	1·189	1·116	55	...	1·375
25	1·245	1·147	60	...	1·419
30	1·306	1·180	65	...	1·463
35	1·372	1·214	70	...	1·508

(Gerlach, Z. anal. **28.** 476.)

Solutions of $MnCl_2$ in 75 % alcohol saturated at t° contain:

t°	% $MnCl_2$	t°	% $MnCl_2$
10	23·1	43·75	37·5
25	36·1	87·5 (B.-pt.)	32·2

Solutions of $MnCl_2$ in absolute alcohol saturated at t° contain:

t°	% $MnCl_2$	t°	% $MnCl_2$
11·25	33·3	76·25 (B.-pt.)	36·2
37·5	33·3		

(Brandes, *l.c.*)

$MnCl_2$ crystallises from above solutions on standing.

When 15-20 vols. ether are added to 1 vol. absolute alcohol sat. with $MnCl_2$, $MnCl_2$ is completely pptd. (Döbereiner.)

Insol. in oil of turpentine.

$+4H_2O$. Deliquescent.

100 pts. H_2O at t° dissolve:

t°	Pts. $MnCl_2$ $+4H_2O$	t°	Pts. $MnCl_2$ $+4H_2O$
8	151	87·5	641
31·25	265	106·25	656
62·5	641	...	...

(Brandes, *l.c.*)

Sol. in 0·8 pt. H_2O at 18·75°. (Abl.)

100 pts. 75 % alcohol dissolve at t°:

t°	Pts. $MnCl_2$ $+4H_2O$	t°	Pts. $MnCl_2$ $+4H_2O$
10	53	43·75	144
25	132	87·5	100·1

Insol. in absolute ether, which also does not abstract its crystal H_2O.

Insol. in boiling oil of turpentine. (Brandes.)

Sol. in conc. HNO_3+Aq.

$+2H_2O$. (Remsen and Saunders, Am. Ch. J. **14.** 127.)

Manganese *sesqui*chloride, Mn_2Cl_6.

Known only in solution.

Manganese *tetra*chloride, $MnCl_4$.

Has not been isolated.

Sol. in H_2O, alcohol, or ether. (Nicklès, J. B. **1865.** 225.)

Composition is Mn_2Cl_6. (Christensen, J. pr. (2) **34.** 41.)

Manganese hydrogen *tetra*chloride (chloromanganic acid), $MnCl_4$, 2HCl.

Sol. in ether; decomp. by H_2O. (Franke, (2) **36.** 31.)

Manganese *hepta*chloride, $MnCl_7$ (?).

Decomp. by H_2O. (Dumas, Berz. J. B. **7.** 112.)

Has the formula MnO_3Cl (?). (Aschoff, J. pr. **81.** 29.)

Manganous mercuric chloride, $MnCl_2$, $HgCl_2+4H_2O$.

Deliquescent in moist air. Easily sol. in H_2O. (v. Bonsdorff.)

Manganous potassium chloride, $MnCl_2$, $KCl+2H_2O$.

Deliquescent. Very sol. in H_2O, but is decomp. thereby. (Remsen and Saunders, Am. Ch. J. **14.** 129.)

Manganous rubidium chloride, $MnCl_2$, 2RbCl. (Godeffroy.)

$+3H_2O$. Easily sol. in H_2O. Insol. in alcohol; conc. $HCl+Aq$ ppt. anhydrous salt from aqueous solution. (Godeffroy, Arch. Pharm. (3) **12.** 40.)

Contains only $2H_2O$. (Saunders, Am. Ch. J. **14.** 139.)

Manganous stannic chloride.

See **Chlorostannate, manganous.**

Manganous fluoride, MnF_2.

Only sol. in H_2O containing HF. (Berzelius.)

Manganomanganic fluoride, $Mn_3F_8+10H_2O$.

Sol. in a little H_2O, but decomp. by dilution. (Nicklès, C. R. **67.** 448.)

Manganese *tetra*fluoride, MnF_4.

Not isolated. Sol. in absolute alcohol or ether; decomp. by H_2O. (Nicklès, C. R. **65.** 107.)

Probably does not exist. (Christensen, J. pr. (2) **35.** 161.)

Manganese ***sesqui*****fluoride,** Mn_2F_6.

Completely sol. in a little H_2O, but decomp. by dilution or boiling. (Berzelius.)

$+6H_2O$. Efflorescent. (Christensen, J. pr. (2) **35.** 57.)

Manganese ***hepta*****fluoride,** MnF_7 (?).

Sol. in H_2O with decomp. (Wöhler.)

Manganese ***sesqui*****fluoride** ***with*** **MF.**

See also **Fluomanganate, M.**

Manganic nickel fluoride, $2NiF_2$, $Mn_2F_6+8H_2O$.

(Christensen, J. pr. (2) **34.** 41.)

Manganic potassium fluoride, Mn_2F_6, $4KF+2H_2O$.

Decomp. by H_2O. Sol. in conc. $HCl+Aq$, dil. HNO_3+Aq, conc. H_2SO_4+Aq, H_3PO_4+Aq, $H_2C_2O_4+Aq$, $H_2C_4H_4O_6+Aq$, and dil. $HF+Aq$. (Christensen, J. pr. (2) **35.** 72.)

MnF_4, 2KF. Difficultly sol. in H_2O. Decomp. by much H_2O. (Nicklès, C. R. **65.** 107.)

True composition is Mn_2F_6, 4KF, also with $2H_2O$. (Christensen, J. pr. (2) **34.** 41.)

MnF_4, 4KF. (Nicklès.)

See also **Fluomanganate, potassium.**

Manganic silver fluoride, 2AgF, $Mn_2F_6+14H_2O$.

Sol. in $HF+Aq$. (Christensen, J. pr. (2) **34.** 41.)

Manganic sodium fluoride, Mn_2F_6, 4NaF.

Decomp. by much H_2O. Not as sol. in $HF+Aq$ as the K salt. (Christensen, J. pr. (2) **35.** 161.)

Manganous stannic fluoride.

See **Fluostannate, manganous.**

Manganic zinc fluoride, $2ZnF_2$, $Mn_2F_6+8H_2O$.

See **Fluomanganate, zinc.**

Manganous zirconium fluoride.

See **Fluozirconate, manganous.**

Manganous hydroxide, MnO_2H_2.

Insol. in H_2O. Very sl. sol. in H_2O or alkalies. (Fresenius.) Easily sol. in acids. Insol. in NaOH, or $KOH+Aq$. Sol. in NH_4 salts $+Aq$. Insol. in NH_4OH+Aq. Sol. in $NaOH+Aq$ in presence of glycerine. (Donath, Dingl. **229.** 542.)

Not pptd. by NH_4OH+Aq in presence of $H_2C_4H_4O_6$; by $KOH+Aq$ in presence of cane sugar; by $KOH+Aq$ in presence of Na citrate.

Min. *Pyrochroite.*

Manganomanganic hydroxide, Mn_3O_4, xH_2O.

Not attacked by boiling NH_4Cl+Aq. Behaves towards acids as Mn_3O_4.

Manganic hydroxide, Mn_2O_3, H_2O.

Insol. in hot or cold dil. H_2SO_4+Aq.

Sol. in conc. H_2SO_4 at somewhat over 100°. (Carius.)

Sol. in tartaric, oxalic, and malic acids, with subsequent decomp. Insol. in formic, acetic, benzoic, or hippuric acids. (Hermann, Pogg. **74.** 303.)

Insol. in NH_4Cl+Aq. Insol. in cane sugar $+Aq$. (Peschier.)

Min. *Manganite.* Sol. in conc. $HCl+Aq$. Sl. sol. in conc. H_2SO_4.

Manganese ***di*****hydroxide,** MnO_2, H_2O.

See **Manganous acid.**

Manganous iodide, MnI_2+4H_2O.

Very deliquescent, and sol. in H_2O.

Manganous oxide, MnO.

Insol. in H_2O. Easily sol. in acids. Readily sol. in NH_4Cl+Aq.

Manganic oxide (Manganese ***sesqui*****oxide),** Mn_2O_3.

Decomp. by boiling with HNO_3+Aq into MnO, which dissolves, and MnO_2, which is insol. (Berthier); also by boiling with dil. H_2SO_4+Aq. (Turner.) Sol. in hot conc. H_2SO_4 or $HCl+Aq$. Sol. in cold $HCl+Aq$ without decomp. If perfectly pure, is insol. in dil. H_2SO_4+Aq, but if it contains any MnO, it dissolves. (Rose.) Insol. in boiling NH_4Cl+Aq.

Solubility in (calcium sucrate + sugar) + Aq.

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 0·50 g. Mn_2O_3; containing 296·5 g. sugar and 24·2 g. CaO dissolves 0·37 g. Mn_2O_3; containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·32 g. Mn_2O_3. (Bodenbender, J. B. **1865.** 600.)

Min. *Braunite.*

Colloidal. Solution in H_2O containing 0·21 g. to a litre is precipitated by KNO_3+Aq (1:1000); K_2SO_4+Aq (1:1100); $(NH_4)_2SO_4+Aq$ (1:1500); $NaCl+Aq$ (1:1580); $MgSO_4+Aq$ (1:40,983); $BaCl_2+Aq$ (1:58,823); $MnSO_4+Aq$ (1:147,929); $(NH_4)_2Al_2(SO_4)_4+Aq$ (1:362,318); $K_2Cr_2(SO_4)_4+Aq$ (1:416,668); $HCl+Aq$ (1:61,350); $HC_2H_3O_2$ (1:17,262); H_2SO_4 (1:62,500). (Spring and de Boeck, Bull. Soc. (2) **48.** 170.)

Manganomanganic oxide, Mn_3O_4.

Insol. in H_2O. Boiling dil. or conc. HNO_3+Aq dissolves out MnO (Berthier); also boiling dil. H_2SO_4+Aq. (Turner.) Sol. in hot $HCl+Aq$. (Otto.) NH_4Cl+Aq dissolves out MnO. (Rose.) Sol. without decomp. in hot very conc. H_3PO_4+Aq, and cold conc. H_2SO_4, HCl, oxalic, and tartaric acids $+Aq$.

Min. *Hausmannite.*

Manganese ***di*****oxide,** MnO_2.

Min. *Pyrolusite.* Insol. in H_2O. Very slowly sol. in conc. H_2SO_4 with evolution of O_2. Sol. in cold $HCl+Aq$; decomp. by hot $HCl+Aq$. Sol. in aqua regia. Sol. in SO_2+Aq or N_2O_3+Aq. (Karsten.)

Insol. in HNO_3, or dil. H_2SO_4+Aq, except in presence of organic reducing substances. Decomp. by citric acid, and more easily by oxalic acid. (Bolton.)

Sl. sol. in hot conc., but insol. in dil. HNO_3+Aq. (Deville.) When pure it is insol. in cold dil. H_2SO_4+Aq, but if a small quantity of MnO is added much MnO_2 dissolves. (Carius.)

Not decomp. by boiling NH_4Cl+Aq.

Easily sol. in a mixture of nitrososulphuric acid and conc. HCl+Aq. (Bornträger, Rep. anal. Ch. **1887**. 741.)

Manganese oxides, Mn_3O_5, Mn_6O_{11}, etc.

See **Manganite, manganous.**

Manganese *tri*oxide, MnO_3.

Deliquescent. Sol. in H_2O, with subsequent decomp. Decomp. by ether. Sol. in conc. H_2SO_4. (Franke, J. pr. (2) **36**. 31.)

Manganese *tetr*oxide, MnO_4 (?).

Sl. sol. in H_2O with decomp. Decomp. by H_2SO_4 or ether. (Franke, J. pr. (2) **36**. 166.)

Manganese *hept*oxide, Mn_2O_7.

Very unstable; takes up H_2O from air. Sol. in H_2O with evolution of heat and rapid decomposition. Sol. in conc. H_2SO_4 without decomp. (Aschoff.)

Manganese oxychloride, $3Mn_2O_3$, $MnCl_2$.

Insol. in H_2O. (Saint-Gilles, C. R. **55**. 329.)

$MnCl_2$, MnO (?). (Gorgeu, A. ch. (6) **4**. 515.)

MnO_3Cl. *See* **Manganyl chloride.**

Manganic oxyfluoride, $MnOF_2$.

Sol. in absolute ether.

$MnOF_2$, $2HF$ = fluoxymanganic acid. (Nicklès, C. R. **659**. 107.)

Manganic oxyfluoride potassium fluoride.

See **Fluoxymanganate, potassium.**

Manganic *sesqui*oxyfluoride potassium fluoride.

See ***Sesqui*fluoxymanganate, potassium**

Manganese oxysulphide, MnO, MnS.

Sol. in acids. (Arfvedson, Pogg. **1**. 50.)

Manganese phosphide, $Mn_5P_2 = Mn_3P_2$, Mn_7P_2.

HCl+Aq dissolves out Mn_3P_2 and leaves Mn_7P_2, which is sol. in HNO_3+Aq. (Wöhler and Merkel, A. **86**. 371.)

xMn_3P_2, yMn_4P_2. Easily sol. in aqua regia; partly sol. in H_2SO_4 or HCl+Aq. (Struve, J. pr. **79**. 321.)

Mn_6P_2. Insol. in HCl+Aq. Sol. in HNO_3+Aq. (Schrötter, W. A. B. **1849**, **1**. 305.)

Manganous phosphoselenide, MnS, P_2Se.

Insol. in H_2O. Sol. in HCl+Aq or HNO_3+Aq. Insol. in cold, sl. decomp. by hot alkalies +Aq. (Hahn, J. pr. **93**. 436.)

$2MnSe$, P_2Se_3. Insol. in cold, slowly sol. in hot HCl+Aq. Not decomp. by alkalies.

$2MnSe$, P_2Se_5. Easily decomp. by acids. (Hahn.)

Manganese silicide, Mg_5Si_2.

Sol. in HCl+Aq with evolution of SiH_4. (Wöhler, A. **106**. 54.)

Manganous sulphide, MnS.

Anhydrous. Insol. in H_2O. Sol. in weak acids, even in acetic acid.

Min. *Alabandite.* Sol. in HCl+Aq.

$+\frac{1}{2}H_2O$. *Green.* Decomp. by boiling with H_2O. Sol. in weak acids, as acetic or sulphurous acid. Very sl. sol. in $(NH_4)_2S$+Aq. (Wackenroder.)

Sol. in NH_4 salts+Aq. 100 ccm. of sat. NH_4Cl+Aq at 12° dissolve 0·43 g. MnS. (Clermont and Guyot, C. R. **85**. 37.)

$+\frac{2}{3}H_2O$. *Flesh-coloured.* Less sol. in NH_4 salts, or acetic acid +Aq than the preceding salt. 100 ccm. of sat. NH_4Cl+Aq at 12° dissolve 0·088 g. (Clermont and Guyot.)

Neither green nor flesh-coloured MnS contains H_2O. (Antony and Donnini, Gazz. ch. it. **23**. 560.)

MnS is not pptd. in presence of alkali citrates, tartrates, or grape sugar; cane or milk sugar do not prevent precipitation. (Spiller.) Not pptd. in presence of $Na_4P_2O_7$. (Rose.)

Manganese *di*sulphide, MnS_2.

(Senarmont, J. pr. **51**. 385.)

Min. *Hauerite.* Decomp. by hot HCl+Aq with separation of S.

Manganous phosphorus sulphide, MnS, P_2S.

Sol. in HCl+Aq with decomp. (Berzelius, A. **46**. 147.)

Manganous potassium sulphide, $3MnS$, K_2S.

Nearly insol. in water, alcohol, or ether. Easily sol. in acids. (Völcker, A. **59**. 35.)

Manganous sodium sulphide, $3MnS$, Na_2S.

Insol. in H_2O, alcohol, or ether. Sol. in dil. acids, and SO_2+Aq. (Völcker.)

$2MnS$, Na_2S. Decomp. by H_2O. (Schneider, Pogg. **151**. 446.)

Manganic acid, H_2MnO_4.

Known only in solution, which decomposes rapidly. (Franke, J. pr. (2) **36**. 31.)

Barium manganate, $BaMnO_4$.

Insol. in H_2O; decomp. by acids. (Mitscherlich.)

Didymium manganate, $Di_2(MnO_4)_3$.

Insol. in H_2O. Sol. in H_2SO_4+Aq. (Frerichs and Smith, A. **191**. 331.)

Does not exist. (Cleve, B. **11**. 912.)

Lanthanum manganate, $La_2(MnO_4)_3$.

Ppt. (Frerichs and Smith, A. **191**. 331.)

Does not exist. (Cleve, B. **11**. 912.)

Manganese manganate, Mn_2O_3, $MnO_3 = 3MnO_2$.

See **Manganese *di*oxide.**

Lead manganate, $PbMnO_4 + 2H_2O$.

Ppt. (Jolles, C. C. **1888**. 58.)

Potassium manganate, K_2MnO_4.

Sol. in water containing alkalies without decomp., but decomp. by pure H_2O. Can be recrystallised from dil. KOH+Aq.

Potassium manganate permanganate, K_2MnO_4, $KMnO_4$.

Sol. without decomp. in 20 % KOH+Aq. (Gorgeu, A. ch. (3) **61**. 355.)

Sodium manganate, $Na_2MnO_4 + 10H_2O$.

Sol. in H_2O, with partial decomp. (Gentele, J. pr. **82**. 58.)

Strontium manganate, $SrMnO_4$.

Insol. in H_2O. (Fromherz.)

***Per*manganic acid.**
See **Permanganic acid.**

Manganicyanhydric acid, $H_3Mn(CN)_6$.
Not known in the free state.

Barium manganicyanide, $Ba_3[Mn(CN)_6]_2$.
Sol. in H_2O. (Fittig and Eaton.)

Calcium manganicyanide, $Ca_3[Mn(CN)_6]_2$.
Sol. in H_2O. (Fittig and Eaton.)

Potassium manganicyanide, $K_3Mn(CN)_6$.
Sol. in H_2O. (Christensen, J. pr. (2) **31**. 163.)

Sodium manganicyanide, $Na_3Mn(CN)_6+2H_2O$.
Sol. in H_2O. (Fittig and Eaton.)

Manganocyanhydric acid, $H_4Mn(CN)_6$.
Most easily decomp. Sl. sol. in alcohol. Insol. in ether. (Descamps, A. ch. (5) **24**. 185.)

Ammonium manganous manganocyanide, $NH_4CN, Mn(CN)_2=(NH_4)_2MnMn(CN)_6$.
Sol. in NH_4CN+Aq. (Fittig and Eaton, A. **145**. 157.)

Barium manganocyanide, $Ba_2Mn(CN)_6$.
Sol. in cold H_2O. (Fittig and Eaton.)

Calcium manganocyanide, $Ca_2Mn(CN)_6$.
Very deliquescent. Sol. in H_2O; insol. in alcohol. (Fittig and Eaton.)

Potassium manganocyanide, $K_4Mn(CN)_6+3H_2O$.
Very efflorescent. Sol. in H_2O; decomp. by boiling.

Potassium manganocyanide chloride, $K_4Mn(CN)_6, KCl$.
Easily sol. in H_2O. (Descamps.)

Potassium manganous manganocyanide, $KCN, Mn(CN)_2=K_2MnMn(CN)_6$.
Ppt. Sol. in $KCN+Aq$.

Sodium manganocyanide, $Na_4Mn(CN)_6+8H_2O$.
Very efflorescent. Easily sol. in H_2O. (Fittig and Eaton.)

Strontium manganocyanide, $Sr_2Mn(CN)_6$.
As the Ba comp. (Descamps.)

Manganosulphuric acid.
See **Sulphate, manganic.**

Manganous acid, $H_2MnO_3=MnO_2, H_2O$.
Insol. in H_2O. (Franke, J. pr. (2) **36**. 451.)
$2MnO_2, H_2O$ (?). Min. *Wad.*

Barium manganite, $BaO, 5MnO_2$.
Sl. sol. in $HCl+Aq$, less sol. in HNO_3+Aq. (Rissler, Bull. Soc. (2) **30**. 111.)
$BaO, 7MnO_2$. (Rousseau, C. R. **104**. 786.)
$BaO, 2MnO_2$. Insol. in H_2O.
BaO, MnO_2. Insol. in H_2O. (Rousseau, C. R. **102**. 425.)
$Ba(H_3Mn_4O_{10})_2$. (Morawski and Stingl, J. pr. (2) **18**. 92.)

Calcium manganite, $CaO, 5MnO_2$.
Easily sol. in $HCl+Aq$, less in HNO_3+Aq. (Rissler.)
$2CaO, MnO_2$. Sol. in dil. min. acids. (Rousseau, C. R. **116**. 1060.)
$CaO, 2MnO_2$. (Rousseau, C. R. **102**. 425.)
$CaO, 3MnO_2$.
CaO, MnO_2. Sol. in fuming $HCl+Aq$, but not in dil. HNO_3+Aq. (Rousseau, C. R. **116**. 1060.)

Cobalt copper manganite, $CoO, CuO, 2MnO_2+4H_2O$.
Min. *Asbolite.* Sol. in $HCl+Aq$, with evolution of Cl.

Cupric *sesqui*manganite, $Mn_2O_3, 3CuO$.
Sol. in $HCl+Aq$. (Schneider, Am. Ch. J. **9**. 269.)

Lead manganite, $PbO, 5MnO_2$.
Not attacked by conc. acids; sol. in aqua regia. (Rissler.)

Magnesium manganite, $2MgO, MnO_2$.
(Lemoine, Ann. Min. (7) **3**. 5.)
$+xH_2O$. (Volhard.)

Manganous manganite, $Mn_3O_5=MnO, 2MnO_2$.
(Reissig, A. **103**. 27.)
$Mn_6O_{11}=MnO, 5MnO_2$. (Veley, Chem. Soc. **38**. 581.)
$3MnO_2, 2MnO$. Decomp. by dil. H_2SO_4+Aq. (Franke, J. pr. (2) **36**. 166.)
$3MnO_2, MnO+H_2O$. Min. *Varvicite.*

Potassium manganite, $K_2O, 2MnO_2$.
Insol. in H_2O.
$K_2O, 5MnO_2$.
$K_2O, 7MnO_2+3H_2O$.
$K_2O, 8MnO_2+3H_2O=KH_3Mn_4O_{10}$. (Morawski and Stingl, J. pr. (2) **18**. 91.)
Does not exist. (Wright and Menke, Chem. Soc. **37**. 22.)
$K_2O, 10MnO_2$.
$K_2O, 16MnO_2+6H_2O$. Sol. in conc. $HCl+Aq$. (Rousseau, C. R. **114**. 72.)

Silver manganite, $AgH_3Mn_4O_{10}$.
(Morawski and Stingl, J. pr. (2) **18**. 92.)
Ag_2MnO_3. Ppt. (Gorgeu, C. R. **110**. 958.)

Argentous manganite, Ag_4O, Mn_2O_3 (?).
Insol. in cold dil. HNO_3+Aq, and separates Mn_2O_3 on warming. Insol. in NH_4OH+Aq. (Rose, Pogg. **101**. 229.)

Argentoargentic manganite, $Ag_4O, 2Ag_2O, Mn_2O_3$ (?).
(Rose.)

Sodium manganite, $Na_2O, 5MnO_2$.
Insol. in H_2O. (Rousseau, C. R. **103**. 261.)
$Na_2O, 12MnO_2$. Insol. in H_2O. (Rousseau.)
$+4H_2O$. (Rousseau, C. R. **112**. 525.)
$Na_2O, 8MnO_2+5H_2O$. (Rousseau.)
$Na_2O, 16MnO_2+8H_2O$. (Rousseau.)

Strontium manganite, MnO_2, SrO.
Insol. in H_2O.
$2MnO_2, SrO$. Insol. in H_2O. (Rousseau, C. R. **101**. 167.)
$MnO_2, 5SrO$. Sol. in HCl, or HNO_3+Aq. (Rissler, Bull. Soc. (2) **30**. 110.)

Zinc manganite, $ZnO, 5MnO_2$.

Insol. in H_2O. (Rissler.)

Manganyl chloride, MnO_3Cl.

Decomp. by H_2O. (Aschoff, J. pr. **81**. 29.)

Melanocobaltic chloride,
$Co_2(NH_3)_6Cl_4NH_2Cl$, or $Co_2(NH_3)_6Cl_5NH_2$.

Very sl. sol. in cold H_2O or very dil. HCl+Aq. Decomp. by long standing or warming. Cold conc. HCl or dil. H_2SO_4+Aq does not attack, but decomp. on warming. HNO_3+Aq decomp. on warming. Sol. in cold H_2SO_4 or NH_4OH+Aq; from both solutions it can be precipitated by HCl+Aq. (Vortmann, B. **10**. 1455.)

—— **chloroplatinate**, $Co_2(NH_3)_6NH_2Cl_5, PtCl_4$.

Ppt. (Vortmann, B. **15**. 1902.)

$Co_2(NH_3)_6NH_2Cl_3(OH)_2, PtCl_4$. Ppt. (Vortmann.)

—— **mercuric chloride**,
$Co_2(NH_3)_6(NH_2)Cl_3(OH)_2, 3HgCl_2+H_2O$.

Ppt. Difficultly sol. in cold H_2O, quite easily in warm H_2O acidified with HCl. (Vortmann.)

—— **chloride chromate**,
$Co_2(NH_3)_6NH_2Cl_3Cr_2O_7+H_2O$.

Sol. in hot H_2O. (Vortmann.)

Mercurammonium comps.

See **Mercury ammonium comps.**

Mercuriammonium bromide, $Hg(NH_2)Br$.

See ***Di*mercuriammonium ammonium bromide.**

Mercuriammonium chloride, $Hg(NH_2)Cl$.

See ***Di*mercuriammonium ammonium chloride.**

Mercuriammonium oxy*di*mercuriammonium chloride, $4Hg(NH_2)Cl, NH_2(HgOHg)Cl$.

(Millon.)

Correct composition is *Di*mercuriammonium ammonium chloride, NHg_2Cl, NH_4Cl, which see. (Balestra, Gazz. ch. it. **21**, **2**. 294.)

$Hg(NH_2)Cl, 2NH_2(HgOHg)Cl$. (Millon.)

Correct composition is *Di*mercuriammonium mercuric chloride, $2NHg_2Cl, HgCl_2+H_2O$, or *Di*mercuriammonium hydrogen chloride, NHg_2Cl, HCl. (Balestra.)

Mercuriammonium nitrate, $2NH_3, 2HgO, N_2O_5=NH_2HgNO_3+\frac{1}{2}H_2O$.

Easily decomp. by HCl, or alkali sulphides+Aq. Sl. sol. in HNO_3+Aq. Insol. in H_2SO_4, NH_4OH, or KOH+Aq. (Mitscherlich.)

Is *di*mercuriammonium ammonium nitrate, $NHg_2NO_3, NH_4NO_3+H_2O$. (Pesci, Gazz. ch. it. **20**. 485.)

Mercuriammonium oxy*di*mercuriammonium nitrate, $3HgO, 2NH_3, N_2O_5=NH_2HgNO_3, (NHg_2OH_2)NO_3+H_2O$.

Decomp. by boiling with H_2O, which dissolves out NH_4NO_3. Sol. in NH_4NO_3+Aq containing NH_4OH. (Mitscherlich.)

Is *di*mercuriammonium ammonium nitrate, $3NHg_2NO_3, NH_4NO_3+2H_2O$. (Pesci, Gazz. ch. it. **20**. 485.)

Mercuriammonium oxy*di*mercuriammonium sulphate, $(NH_2Hg)_2SO_4, 3(NHg_2OH_2)_2SO_4$.

Boiling H_2O dissolves out H_2SO_4. Gradually decomp. by boiling KOH+Aq. Completely sol. in NH_4Cl+Aq. Sol. in conc. or dil. HCl, or very dil. H_2SO_4+Aq. Insol. in conc. or dil. HNO_3+Aq or conc. H_2SO_4. (Schneider.)

Correct formula is $7(NHg_2)_2SO_4, (NH_4)_2SO_4+12H_2O$, *di*mercuriammonium ammonium sulphate. (Pesci, Gazz. ch. it. **20**. 485.)

Mercuri*di*ammonium chloride (fusible white precipitate), $Hg(NH_3)_2Cl_2$.

Is *di*mercuriammonium ammonium chloride, $Hg_2NCl, 3NH_4Cl$, which see. (Rammelsberg J. pr. **38**. 558.)

Mercuri*di*ammonium mercuric chloride,
$Hg(NH_3)_2Cl_2, HgCl_2$.

Insol. in H_2O, but gradually decomp. by boiling therewith. (Rose, Pogg. **20**. 158.)

Partly sol. in H_2O. (Kane.)

Mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$.

H_2O extracts all the NH_3. Partly sol. in little alcohol. Partly sol. in ether without decomp. (Nessler.)

Correct composition is *di*mercuriammonium ammonium iodide, $NHg_2I, 3NH_4I$. (Pesci, Gazz. ch. it. **20**. 485.)

Mercuri*di*ammonium cupric iodide, $4NH_3, CuI_2, HgI_2$.

Decomp. by H_2O. Sol. in alcohol+$HC_2H_3O_2$. (Jörgensen, J. pr. (2) **2**. 347.)

$2Hg(NH_3)_2I_2$. CuI_2. Decomp. by H_2O. (Jörgensen.)

Mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$.

Decomp. by H_2O. Partly sol. in a little alcohol. Partly sol. in ether. (Nessler.)

Correct composition is *di*mercuriammonium ammonium iodide, $NHg_2I, 3NH_4I$. (Pesci.)

Mercuri*di*ammonium mercuric iodide,
$Hg(NH_3)_2I_2, HgI_2$, or NH_3, HgI_2.

Decomp. by H_2O or dil. acids. (Caillot and Corriol, J. Pharm. **9**. 381.)

Correct composition is *di*mercuriammonium ammonium mercuric iodide, $3NHg_2I, 8NH_4I, 4HgI_2$. (Pesci, Gazz. ch. it. **20**. 485.)

Mercuri*di*ammonium sulphate, $Hg(NH_3)_2SO_4$.

Decomp. with H_2O.

Does not exist. (Pesci, Gazz. ch. it. **20**. 485.)

$+H_2O$. Decomp. by H_2O. Easily sol. in HCl, very dil. H_2SO_4+Aq, or HNO_3+Aq. Insol. in conc. HNO_3+Aq. Sol. in $(NH_4)_2SO_4$+Aq or NH_4Cl+Aq. Decomp. by KOH+Aq. (Schneider, J. pr. **75**. 136.)

Correct composition is $(NHg_2)_2SO_4, 3(NH_4)_2SO_4+12H_2O$, *di*mercuriammonium ammonium sulphate. (Pesci.)

***Di*mercuriammonium acetate**,
$NHg_2C_2H_3O_2$.

Insol. in H_2O or alcohol. Sol. in HCl or

$NH_4C_2H_3O_2+Aq$. (Balestra, Gazz. ch. it. **22**, **2**. 563.)

*Di***mercuriammonium ammonium acetate,** $NHg_2C_2H_3O_2, 3NH_4C_2H_3O_2+H_2O$.

Deliquescent; sol. in a little H_2O without decomp., but decomp. into $NHg_2C_2H_3O_2$ and $NH_4C_2H_3O_2$ by excess of H_2O. (Balestra.)

—— **arsenate,** $NHg_2H_2AsO_4$.

(Hirzel, Zeit. Pharm. **1853**. 3.)

—— **bromate,** $NHg_2BrO_3+1\frac{1}{2}H_2O$.

Ppt. (Rammelsberg, Pogg. **55**. 82.)

Is oxy*di*mercuriammonium bromate, $(NH_2Hg_2O)BrO_3$.

—— **bromide,** NHg_2Br.

Insol. in H_2O or HNO_3. Sol. in $HCl+Aq$. (Pesci, Gazz. ch. it. **19**. 509.)

Sol. in KI, or $Na_2S_2O_3+Aq$ with evolution of NH_3. (Balestra, Gazz. ch. it. **22**, **2**. 558.)

—— **ammonium bromide,** NHg_2Br, NH_4Br.

Decomp. by H_2O. (Pesci, Gazz. ch. it. **19**. 511.)

$4NHg_2Br, 5NH_4Br$. Decomp. by H_2O. Insol. in $(NH_4)_2CO_3+Aq$. Sol. in conc. or dil. $HCl+Aq$. Insol. in HNO_3+Aq. (Pesci.)

$NHg_2Br, 3NH_4Br$. Decomp. by H_2O. Easily sol. in $HCl+Aq$. Insol. in alcohol. (Pesci.)

Sol. in NH_4Br, NH_4Cl, or NH_4I+Aq; sol. in KI, or $Na_2S_2O_3+Aq$.

—— **carbonate,** $(NHg_2)_2CO_3+2H_2O$.

Ppt. Not decomp. by $KOH+Aq$, but easily by K_2S, or $KI+Aq$. (Rammelsberg, J. pr. (2) **38**. 567.)

—— **chloride,** NHg_2Cl.

Not attacked by boiling H_2O. Sl. attacked by cold dil. $HCl+Aq$, but is gradually dissolved thereby. Decomp. by hot $KOH+Aq$. (Weyl.)

Sol. in KI, or $Na_2S_2O_3+Aq$ with evolution of NH_3.

$+H_2O$. Nearly insol. in H_2O; easily sol. in HNO_3, and $HCl+Aq$. Not decomp. by $KOH+Aq$. Decomp. by KCl, NaCl, or $KI+Aq$. (Rammelsberg, Pogg. **48**. 181.)

—— **hydrogen chloride,** $NHg_2Cl, 2HCl$.

Correct composition of mercuric chloramide chloride. (Balestra, Gazz. ch. it. **21**, **2**. 299.)

Decomp. by H_2O.

NHg_2Cl, HCl. Decomp. by H_2O. (Balestra, *l.c.*)

—— **ammonium chloride,** NHg_2Cl, NH_4Cl. (**Infusible white precipitate**).

Correct composition of what has been called mercuric chloramide, $Hg(NH_2)Cl$. (Rammelsberg, J. pr. **38**. 558.)

Insol. in cold, decomp. by hot H_2O. (Millon, A. ch. (3) **18**. 413.) Sol. in 600 pts. H_2O. (Wittstein.) Sol. in 719·98 pts. H_2O at 18·75°. (Abl.) Insol. in alcohol.

Sol. in acids, even in $HC_2H_3O_2+Aq$, also in NH_4NO_3, $(NH_4)_2SO_4$, and $NH_4C_2H_3O_2+Aq$. (Pelouze and Fremy.)

Sol. in warm NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sl. sol. in alkali chlorides $+Aq$, which partially decomp. (Miahle, A. ch. (3) **5**. 180.)

Decomp. by $KOH+Aq$. Sol. in KI, or $Na_2S_2O_3+Aq$, with evolution of NH_3. (Balestra.)

$NHg_2Cl, 3NH_4Cl$ (**Fusible white precipitate**).

Correct composition of what has been called mercuri*di*ammonium chloride, $Hg(NH_3)_2Cl_2$. (Rammelsberg, J. pr. (2) **38**. 558.)

Decomp. by hot H_2O. Sol. in acids, even $HC_2H_3O_2+Aq$. Not decomp. by cold, but by boiling $KOH+Aq$. (Weyl.)

Sol. in warm, less in cold NH_4OH+Aq. (Mitscherlich.)

Sol. in KI, or $Na_2S_2O_3+Aq$, with evolution of NH_3. (Balestra.)

*Di***mercuriammonium mercuric chloride,** $2NHg_2Cl, HgCl_2$.

Insol. in, and not decomp. by boiling H_2O, alkalies, conc. HNO_3, or dil. H_2SO_4+Aq. Sol. in boiling $HCl+Aq$. (Mitscherlich, J. pr. **19**. 453.)

—— **chromate.**

See **Oxy*di*mercuriammonium chromate.**

—— **hydroxide,** NHg_2OH.

Takes up H_2O to form NHg_2OH+H_2O or $(NHg_2OH_2)OH$, oxy*di*mercuriammonium hydroxide, which also see.

Sol. in warm HCl or HNO_3+Aq.

—— **iodate,** $NHg_2IO_3, 2NH_4IO_3$.

Insol. in HNO_3. (Rammelsberg, J. pr. (2) **38**. 568.)

—— **iodide,** NHg_2I.

Insol. in H_2O. Sol. in $HCl+Aq$. Decomp. by boiling with $KOH+Aq$ or $KCl+Aq$. (Weyl, Pogg. **121**. 601.) Decomp. by hot KI, or $Na_2S_2O_3+Aq$. (Balestra.)

$+H_2O$. *See* **Oxy*di*mercuriammonium iodide.**

—— **ammonium iodide,** $NHg_2I, 3NH_4I$.

Correct composition of mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$. (Pesci, Gazz. ch. it. **20**. 485.)

$3NHg_2I, 8NH_4I, 4HgI_2$. Correct formula for mercuri*di*ammonium mercuric iodide, $Hg(NH_3)_2I_2, HgI_2$. (Pesci.)

—— **nitrate,** NHg_2NO_3.

Insol. in H_2O. (Rammelsberg, J. pr. (2) **38**. 566.)

Sol. in KI, or $Na_2S_2O_3+Aq$, with evolution of NH_3. (Balestra, Gazz. ch. it. **22**, **2**. 560.)

—— **ammonium nitrate,** $NHg_2NO_3, NH_4NO_3+H_2O$.

Correct formula for mercuriammonium nitrate, $NH_2HgNO_3+\frac{1}{2}H_2O$. (Pesci, Gazz. ch. it. **20**. 485.)

$NHg_2NO_3, 2NH_4NO_3+2H_2O$. Correct formula for oxy*di*mercuriammonium ammonium nitrate, $(NHg_2OH_2)NO_3, 2NH_4NO_3+H_2O$. (Pesci.)

$NHg_2NO_3, 3NH_4NO_3$. Decomp. by cold H_2O; sol. in NH_4OH+Aq. (Pesci.)

$3NHg_2NO_3, NH_4NO_3+2H_2O$. Correct formula for mercuriammonium oxy*di*mercuriammonium nitrate, NH_2HgNO_3, $(NHg_2OH_2)NO_3+H_2O$. (Pesci.)

***Di*mercuriammonium oxide,** $(NHg_2)_2O$.

Slowly decomp. by H_2O. Sol. in HCl, or HNO_3+Aq. Decomp. by hot KOH, or KCl+Aq. (Weyl, Pogg. **121.** 601.)

—— **phosphate,** $(NHg_2)_2PO_4$, $2NHg_2OH+10H_2O$.

(Rammelsberg, J. pr. (2) **38.** 567.)
See **Oxy*di*mercuriammonium phosphate.**

—— **ammonium salicylate,** $2NHg_2C_6H_4OHCO_2$, $5NH_4C_6H_4OHCO_2$.

Decomp. by H_2O. Sol. in $NH_4C_2H_3O_2$, HCl, or KI+Aq. (Balestra.)

—— **selenate,** $(NHg)_2SeO_4+2H_2O$.

Ppt. Insol. in H_2O; sol. in NH_4OH+Aq. (Cameron and Davy, C. N. **44.** 63.)

—— **sulphate,** $(NHg_2)_2SO_4+2H_2O$.

Insol. in H_2O. Easily sol. in HCl+Aq. (Rammelsberg, J. pr. (2) **38.** 565.) Sol. (Kane), insol. (Hirzel) in HNO_3+Aq.

Sol. in KI, or $Na_2S_2O_3$+Aq with evolution of NH_3. (Balestra.)

—— **ammonium sulphate,** $(NHg_2)_2SO_4$, $3(NH_4)_2SO_4+4H_2O$.

Correct formula for mercuri*di*ammonium sulphate, $2NH_3$, HgO, SO_3+H_2O. (Pesci, Gazz. ch. it. **20.** 485.)

$5(NHg_2)_2SO_4$, $14(NH_4)_2SO_4+16H_2O$. (Pesci.)

$7(NHg_2)_2SO_4$, $(NH_4)_2SO_4+12H_2O$. Correct formula for mercuriammonium oxy*di*mercuriammonium sulphate, $(NHg_2H_2)_2SO_4$, $3(NHg_2OH_2)_2SO_4$. (Pesci.)

—— **tartrate,** $(NHg_2)_2C_4H_4O_6+2\frac{1}{2}H_2O$.

Insol. in H_2O. Sol. in HCl, KI, $Na_2S_2O_3$, $NH_4C_2H_3O_2$, or $(NH_4)_2C_4H_4O_6$+Aq. (Balestra, Gazz. ch. it. **22, 2.** 563.)

—— **ammonium tartrate,** $2(NHg_2)_2C_4H_4O_6$, $(NH_4)_2C_4H_4O_6+H_2O$.

As above. (B.)

***Tri*mercuriammonium sulphate,** $(NHg_2)(NHgH_2)SO_4+2H_2O$.

Decomp. by H_2O. (Millon.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

***Di*mercuriarsonium mercuric chloride,** $AsHg_3Cl_3=AsHg_2Cl$, $HgCl_2$.

Decomp. by H_2O. Decomp. by warm HNO_3+Aq. (Rose, Pogg. **51.** 423.)

Mercurimidosulphonic acid, $(HO_3S)_4N_2Hg$.

Very unstable. (Berglund, B. **9.** 256.)

Barium mercurimidosulphonate, $Ba_2(SO_3)_4N_2Hg+5H_2O$.

(Berglund, B. **9.** 256.)

Cadmium ——, $Cd_2HgN_2(SO_3)_4+12H_2O$.

Unstable; sl. sol. in H_2O. (Berglund, Bull. Soc. (2) **25.** 452.)

Cobalt ——, $Co_2HgN_2(SO_3)_4+15H_2O$.

Sol. in H_2O. (B.)

Copper mercurimidosulphonate, $Cu_2HgN_2(SO_3)_4+15H_2O$.

Very sol. in H_2O. (B.)

Magnesium ——, $Mg_2HgN_2(SO_3)_4+15H_2O$.

Very sol. in H_2O. (B.)

Manganous ——, $Mn_2HgN_2(SO_3)_4+10H_2O$.

Unstable. (B.)

Mercuric ——, $(Hg_2O)_2HgN_2(SO_3)_4$.

Nearly insol. in H_2O. (B.)

Nickel ——, $Ni_2HgN_2(SO_3)_4+15H_2O$.

(B.)

Potassium ——, $(KO_3S)_4N_2Hg+4H_2O$.

Precipitate. (Raschig, A. **241.** 161.)

Potassium silver ——, $(AgSO_3)_2(KSO_3)_2HgN_2+3H_2O$.

Sl. sol. in H_2O. (Berglund.)

Sodium ——, $(NaSO_3)_4HgN_2+5H_2O$.

More sol. in H_2O than K salt. (Berglund.)

Strontium ——, $Sr_2(SO_3)_4HgN_2+15H_2O$.

More sol. than Ba salt. (B.)

Zinc ——, $Zn_2(SO_3)_4HgN_2+15H_2O$.

Very sol. in H_2O. (B.)

***Di*mercuriphosphonium mercuric chloride,** PHg_2Cl, $HgCl_2+1\frac{1}{2}H_2O$.

Decomp. by hot, slowly by cold H_2O into Hg, HCl, and H_3PO_3. Decomp. by acids or alkalies. (Rose, Pogg. **40.** 75.)

***Di*mercuriphosphonium mercuric nitrate,** P_2Hg_3, 6HgO, $3N_2O_5=2[PHg_2NO_3, Hg(NO_3)_2]$, 3HgO.

(Rose, Pogg. **40.** 75.)

***Di*mercuriphosphonium mercuric sulphate,** P_2Hg_3, 6HgO, $4SO_3+4H_2O=(PHg_2)_2SO_4$, $3HgSO_4$, $2HgO+4H_2O$.

Sol. in aqua regia. (Rose, Pogg. **40.** 75.)

Mercuric acid.

Calcium mercurate (?).

(Berthollet, A. ch. **1.** 61.)

Potassium mercurate, K_2O, 2HgO.

Gradually decomp. by H_2O; less rapidly by absolute alcohol. (St. Meunier, C. R. **60.** 557.)

Sodium mercurate, Na_2O, HgO.

(Bettekoff, Bull. Soc. (2) **34.** 328.)

Mercuroammonium chloride, $Hg(NH_3)Cl$.

(Rose, Pogg. **20.** 158.)

Mixture of Hg, $HgNH_2Cl$, and NH_4Cl. (Barfoed, J. pr. (2) **39.** 201.)

—— **nitrate,** $(NHg_2H_2)NO_3$, "*Hahnemann's soluble mercury.*"

Sol. in hot HCl, and $HC_2H_3O_2$+Aq. Decomp. by NH_4OH+Aq, or NH_4 salts +Aq. Probably mixture of mercurous salts and Hg.

Mercuro*di*ammonium chloride, $Hg_2(NH_3)_2Cl_2$.

Easily decomp. (Rose, Pogg. **20.** 158.)

Mixture of Hg, NH_2HgCl, and NH_4Cl. (Barfoed, J. pr. (2) **39.** 201.)

Mercuro*di*ammonium fluoride, $Hg_2(NH_3)_2F_2$ (?).

Decomp. by H_2O. (Finkener, Pogg. **110.** 147.)

Mercurosulphonic acid.

Mercurosulphonates, $Hg(SO_3M)_2$.

Correct composition for the double sulphites, $HgSO_3$, M_2SO_3. (Divers and Shimidzu, Chem. Soc. **49.** 583 ; Barth, Z. phys. Ch. **9.** 195.)

Mercuroxy- comps.

See **Oxymercur- comps.**

Mercury, Hg.

Not attacked by H_2O. Not attacked by boiling conc. HCl or dil. H_2SO_4+Aq. Easily sol. in dil. or conc. HNO_3+Aq ; also in HBr or HI+Aq.

Not attacked by pure HNO_3 unless heated, but readily attacked by cold dil. HNO_3+Aq containing NO. (Millon.)

Alkali chlorides + Aq in presence of air decomp. Hg ; action is not increased by heat. (Miahle.)

Mercury ammonium comps.

See—

Mercuroammonium comps., NH_3HgR.

***Di*mercuroammonium comps.,** NH_2Hg_2R.

Mercurous chloramide, $Hg(NH_2)Cl$.

***Di*mercuriammonium comps.,** NHg_2R.

Mercuric chlor-, brom-, etc., amide, $Hg(NH_2)R$.

Mercuri*di*ammonium comps., $Hg(NH_3)_2R$.

Mercuriammonium comps., $HgNH_2R$.

***Di*mercuri*di*ammonium comps.,** $Hg_2N_2H_4R$.

***Tri*mercuriammonium comps.,** $N_2H_2Hg_3R$.

Oxy*di*mercuriammonium comps., $(NH_2Hg_2O)R$.

Mercurous arsinchloride, AsHgCl.

Decomp. by H_2O. (Capitaine, J. Pharm. **25.** 559.)

Mercurous arsinchloride chloride, $AsHg_2Cl_2$=2AsHgCl, Hg_2Cl_2 (?).

Decomp. by H_2O. (Capitaine.)

Mercurous azoimide, HgN_3.

Wholly insol. in H_2O. (Curtius, B. **24.** 3324.)

Mercuric bromamide, $Hg(NH_2)Br$.

Insol. in H_2O and alcohol. Sl. sol. in NH_4OH+Aq. (Mitscherlich, J. pr. **19.** 455.)

Correct composition is *di*mercuriammonium ammonium bromide, Hg_2NBr, NH_4Br, which see. (Pesci, Gazz. ch. it. **19.** 511.)

Mercurous bromide, Hg_2Br_2.

Insol. in H_2O and dil. acids. Decomp. by HCl+Aq. Sol. in hot conc. H_2SO_4 with evolution of SO_2. Sl. sol. in hot HNO_3+Aq of 1·42 sp. gr. (Stromann, B. **20.** 2818.)

Decomp. into Hg and $HgBr_2$ by boiling with NH_4Br, or NH_4Cl+Aq ; also by ammonium carbonate or succinate, but not by ammonium sulphate or nitrate. (Wittstein.)

Sol. in $Hg(NO_3)_2$+Aq. (Wackenroder, A. **41.** 317.)

Partially decomp. by alkali chlorides +Aq ; when out of contact of air this decomp. is slight and $HgBr_2$ is formed, while in the air $HgCl_2$ is the resulting product. Much more rapidly decomp. in hot than cold solutions. (Miahle, A. ch. (3) **5.** 177.)

Insol. in alcohol.

Mercuric bromide, $HgBr_2$.

Sol. in 94 pts. H_2O at 9°, and in 4-5 pts. at 100°. (Lassaigne, J. chim. méd. **12.** 177.)

Sol. in 250 pts. H_2O at ordinary temp., and 25 pts. boiling H_2O. (Wittstein.) Sol. in 240 pts. H_2O at 18·75°. (Abl.)

Decomp. by warm HNO_3, or H_2SO_4+Aq. Sol. in warm H_2SO_4. (Ditte, A. ch. (5) **17.** 124.)

Easily sol. in alcohol, and more easily in ether. (Balard.) Sl. sol. in cold, easily in hot benzene. Sol. in 12 pts. cold, 3 pts. hot alcohol.

Easily sol. in acetone. (Oppenheim, B. **2.** 572.)

$+4H_2O$. (Thomsen.)

Mercuric hydrogen bromide (Bromomercuric acid), $HgBr_2$, HBr=$HHgBr_3$.

Decomp. by H_2O. (Neumann, M. **10.** 236.)

Mercuric potassium bromide, $HgBr_2$, KBr.

Sol. in H_2O, but decomp. by a large amount, with separation of one half of the $HgBr_2$. (v. Bonsdorff, Pogg. **19.** 339.)

$2HgBr_2$, KBr+$2H_2O$. Permanent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Mercuric sodium bromide, $HgBr_2$, NaBr.

Deliquescent. (v. Bonsdorff.)

$2HgBr_2$, NaBr+$3H_2O$. Sol. in H_2O and alcohol. (Berthemot.)

Mercuric strontium bromide, $HgBr_2$, $SrBr_2$.

Sol. in all proportions of H_2O. (Löwig, Mag. Pharm. **33.** 7.)

$2HgBr_2$, $SrBr_2$. Decomp. by H_2O into $HgBr_2$ and $HgBr_2$, $SrBr_2$. (Löwig.)

Mercuric zinc bromide.

Deliquescent in moist air. (v. Bonsdorff.)

Mercuric zinc bromide cyanide ammonia.

See **Cyanide zinc bromide ammonia, mercuric.**

Mercuric bromoiodide, HgBrI.

Sol. in alcohol and ether. Can be recrystallised from ether without decomp. (Oppenheim, B. **2.** 571.)

Mercurous chloramide, $Hg_2(NH_2)Cl$.

Insol. in boiling H_2O or NH_4OH+Aq. (Kane, A. ch. (2) **72.** 215.)

Mixture of Hg and $HgNH_2Cl$. (Barfoed, J. pr. (2) **39.** 201.)

Mercuric chloramide, $Hg(NH_2)Cl$.

Composition is *di*mercuriammonium ammonium chloride, Hg_2NCl, NH_4Cl, which see.

Mercuric chloramide oxymercuriammonium chloride, $4Hg(NH_2)Cl, (NHg_2OH_2)Cl$.

(Millon.)

Correct composition is *di*mercuriammonium ammonium chloride, NHg_2Cl, NH_4Cl, which see. (Balestra, Gazz. ch. it. **21**, **2**. 294.)

$Hg(NH_2)Cl, (NHg_2OH_2)Cl$. (Millon.)

True composition is *di*mercuriammonium mercuric chloride, $2Hg_2NCl, HgCl_2+H_2O$; or *di*mercuriammonium hydrogen chloride, NHg_2Cl, HCl. (Balestra.)

Mercuric chloramide chloride, $Hg(NH_2)Cl, HgCl_2$.

Properties as mercuric chloramide. Decomp. by cold HCl+Aq. (Millon.)

True composition is *di*mercuriammonium hydrogen chloride, $NHg_2Cl, 2HCl$. (Balestra, Gazz. ch. it. **21**, **2**. 294.)

Mercuric chloramide chromate, $2Hg(NH_2)Cl, HgCrO_4$.

Decomp. by hot H_2O. Easily sol. in HNO_3 or HCl+Aq. (Jäger and Krüss, B. **22**. 2048.)

Mercurous chloride, Hg_2Cl_2.

Almost absolutely insol. in cold, but gradually sl. decomp. by boiling H_2O. Calculated from electrical conductivity of Hg_2Cl_2+Aq, 1 l. H_2O dissolves 3·1 mg. Hg_2Cl_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Sl. sol. with decomp. in boiling H_2O free from air, 20 ccm. H_2O affording 0·002 g. $HgCl_2$ after boiling 1 hour with Hg_2Cl_2. (Miahle, A. ch. (3) **5**. 176.) $Hg_2(NO_3)_2$+Aq containing 1 pt. $Hg_2(NO_3)_2$ to 250,000 pts. H_2O gives ppt. of Hg_2Cl_2 with HCl+Aq. Sol. with decomp. in conc. HCl+Aq, hot HNO_3+Aq, aqua regia, or Cl_2+Aq. (Fresenius.) Insol. in cold dil. acids, but slowly sol. on heating.

The solubility of Hg_2Cl_2 in HCl+Aq increases slowly with time, and finally reaches a point where it increases very rapidly, which takes place sooner the more dil. the acid. Presence of $Hg_2(NO_3)_2$+Aq helps the solubility. (Why not oxidation to $HgCl_2$?) (Varenne, C. R. **92**. 1161.)

Sol. in cold HCN+Aq with separation of Hg.

Sol. in alkali chlorides+Aq. NH_4Cl+Aq dissolves out $HgCl_2$ at ord. temp., much more at 40-50°. Dil. NH_4Cl+Aq decomposes more slowly than conc. Access of air hastens reaction. (Miahle.)

When heated several hours to 40-50°,—100 pts. NH_4Cl+833 pts. H_2O form 0·75 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2; 100 pts. NaCl+833 pts. H_2O form 0·33 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2; 100 pts. KCl+833 pts. H_2O form 0·25 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2; 100 pts. $BaCl_2$+833 pts. H_2O form 0·33 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2. (Miahle, J. Pharm. **26**. 108.)

Other chlorides act as NH_4Cl, only less vigorously. (Pettenkofer.)

By boiling 1 pt. Hg_2Cl_2 10 times with a solution of 1 pt. NaCl each time, the Hg_2Cl_2 is finally completely decomp. (Hennel.)

Boiling $BaCl_2$+Aq or $CaCl_2$+Aq dissolve traces. K_2SO_4+Aq, KNO_3+Aq, or $KHC_4H_4O_6$+Aq do not dissolve. (Pettenkofer.)

Sol. in $(NH_4)_2SO_4$+Aq. Insol. in NH_4 nitrate, or succinate+Aq. (Wittstein.)

Sol. in hot $Hg_2(NO_3)_2$+Aq, and still more in hot $Hg(NO_3)_2$+Aq; on cooling it crystallises out completely. 25 g. Hg_2Cl_2 dissolve in 1·5 l. H_2O containing 50 g. $Hg(NO_3)_2$. (Debray, C. R. **70**. 995.)

Sol. in $PtCl_2$+Aq.

Decomp. by NH_4OH+Aq.

Decomp. by KOH, or NaOH+Aq.

Insol. in alcohol or ether. More sol. in H_2O containing pepsin and an acid than in H_2O, and is not converted thereby into $HgCl_2$. (Torsellini, Ann. Chim. farm. (4) **4**. 105.)

Insol. in acetone. (Krug and M'Elroy.)

Mercuric chloride, $HgCl_2$.

Permanent.

Sol. in 18·5 pts. H_2O at 13·8°, and 2·8 pts. at 100°. (J. Davy, **1822**.) Sol. in 3 pts. boiling H_2O. (Wenzel.) Sol. in 18·23 pts. H_2O at 10°, and 3 pts. at 100°. (M. R. and P.) Sol. in 18·46 pts. at 18·75°. (Abl.) Sol. in 16 pts. cold, and 3 pts. warm H_2O. (Dumas.)

100 pts. H_2O dissolve pts. $HgCl_2$ at t°:

t°	Pts. $HgCl_2$	t°	Pts. $HgCl_2$	t°	Pts. $HgCl_2$
0	5·73	40	9·62	80	24·30
10	6·57	50	11·34	90	37·05
20	7·39	60	13·86	100	53·96
30	8·43	70	17·29	...	...

(Poggiale, A. ch. (3) **8**. 468.)

$HgCl_2$+Aq sat. at 8° has 1·041 sp. gr. (Anthon, **1837**.)

Sp. gr. of $HgCl_2$+Aq at 20°.

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
1	1·0072	4	1·0323
2	1·0148	5	1·0411
3	1·0236	...	..

(Schröder, calculated by Gerlach, Z. anal. **27**. 306.)

Sp. gr. of $HgCl_2$+Aq at 15°.

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
8	1·071	11	1·1035
9	1·0815	12	1·115
10	1·095	13	1·127

(Mendelejeff, calculated by Gerlach, Z. anal. **27**. 306.)

Sp. gr. of $HgCl_2$+Aq.

% $HgCl_2$	Sp. gr.			
	at 0°	at 10°	at 20°	at 30°
4·72	1·04070	1·04033	1·03856	1·03566
3·57	1·03050	1·03022	1·02885	1·02577
2·42	1·02035	1·02018	1·01856	1·01585
1·22	1·01008	1·00990	1·00835	1·00575

(Schröder, B. **19**. 161 R.)

Sat. $HgCl_2$+Aq boils at 101·1°. (Griffiths.)

B.-pt. of $HgCl_2$+Aq containing x % $HgCl_2$.

% $HgCl_2$	B.-pt.	% $HgCl_2$	B.-pt.
4·8	100·10°	11·04	100·20°
9·0	100·16	15·2	100·275

(Skinner, Chem. Soc. **61**. 340.)

Solubility in HCl+Aq is greater than in H_2O. (Dumas.)

Sol. in 0·5 pt. HCl+Aq of 1·158 sp. gr. at 23·3°, forming a solution of 2·412 sp. gr. (Davy, **1822**.)

Solubility of $HgCl_2$ in HCl+Aq.

Pts. HCl in 100 pts. H_2O	Pts. $HgCl_2$ dissolved by 100 pts. liquid	Pts. HCl in 100 pts. H_2O	Pts. $HgCl_2$ dissolved by 100 pts. liquid
0·0	6·8	21·6	127·4
5·6	46·8	31·0	141·9
10·1	73·7	50·0	148·0
13·8	87·8	68·0	154·0

(Ditte, A. ch. (5) **22**. 551.)

Solubility in HCl+Aq at 0°. $\frac{HgCl_2}{2}=\frac{1}{2}$ mols. $HgCl_2$ (in mgs.) in 10 ccm. solution; HCl = mols. HCl ditto; H_2O = grms. H_2O present.

$\frac{HgCl_2}{2}$	HCl	Sp. gr.	H_2O
9·7	4·3	1·117	9·704
19·8	9·9	1·238	9·340
35·5	17·8	1·427	9·816
55·6	26·9	1·665	8·135
68·9	32·25	1·811	7·714
72·37	34·25	1·874	7·679
85·5	41·5	2·023	7·131
88·65	48·1	2·066	6·893
95·675	70·875	2·198	6·431

(Engel, A. ch. (6) **17**. 362.)

Not decomp. by H_2SO_4 or HNO_3+Aq.

Sol. in 630 pts. H_2SO_4, and in more than 500 pts. hot HNO_3+Aq of 1·41 sp. gr. without decomp. (*J. Davy.*)

Sol. in H_2SO_4, HNO_3, HIO_3, or H_2CrO_4 without decomp. (Millon, A. ch. (3) **18**. 373.)

Very sl. sol. in HNO_3, but not decomp. thereby. (Wurtz.)

Sat. NH_4Cl+Aq dissolves 17 times as much $HgCl_2$ as H_2O dissolves. (*J. Davy.*)

1 pt. sat. NaCl+Aq dissolves 1·29 pts. $HgCl_2$ at 14°. (Voit, A. **104**. 354.)

Sat. NaCl+Aq (20 grains H_2O+7 grains NaCl) dissolves 32 grains $HgCl_2$ at 15·5°, and 3 grains more on warming. Sp. gr. of solution=2·14. (Davy, **1822**.)

Sat. KCl+Aq (22 grains H_2O+7 grains KCl) dissolves 8 grains $HgCl_2$ on being gently heated. (Davy.)

Sat. $BaCl_2$+Aq (20 grains H_2O+4·7 grains $BaCl_2$+$2H_2O$) dissolves 16 grains $HgCl_2$ at 15·5°, and 6 grains more on heating. Sp. gr. of solution =1·9. (Davy.)

$MgCl_2$+Aq (31 grains HCl+Aq of 1·16 sp. gr. neutralised with MgO) dissolves 46 grains $HgCl_2$, and 25 grains more on gently heating. Sp. gr. of solution =2·28. (Davy.)

Sol. in sat. KCl, NaCl+Aq, and in $MnCl_2$, $ZnCl_2$, $CoCl_2$, $FeCl_2$, $NiCl_2$, and $CdCl_2$+Aq. (v. Bonsdorff, Pogg. **17**. 115.)

Solubility in NaCl+Aq. 100 pts. NaCl+Aq containing given % NaCl dissolve g. $HgCl_2$.

% NaCl	g. $HgCl_2$ at 15°	g. $HgCl_2$ at 60°	g. $HgCl_2$ at 100°
26	128	152	208
25	120	142	196
10	58	68	110
5	30	36	64
1	14	18	48
0·5	10	13	44

(Homeyer and Ritsert, Pharm. Ztg. **33**. 738.)

Sol. in 2·5 pts. cold alcohol (Richter); 3 pts. (Karl); 2·5 pts. alcohol of 0·833 sp. gr. at ordinary temp., and 1·167 pts. on boiling (Berzelius); 3 pts. alcohol of 0·816 sp. gr. at 15·5 (sp. gr. of solution=1·08) (J. Davy, Phil. Trans. **1822**. 358).

At 10°,—sol. in 2·57 pts. alcohol of 39° (Cartier), in 2·9 pts. alcohol of 38°; in 3·6 pts. alcohol of 35°; in 4·9 pts. alcohol of 30°; in 9·3 pts. alcohol of 22°; in 14·6 pts. alcohol of 14°. (N. E. Henry.)

Sol. in 25 mols. methyl, 13·1 mols. ethyl, and 20·3 mols. propyl alcohol at 8·5°; in 16·2 mols. methyl, 12·4 mols. ethyl, and 18 mols. propyl alcohol at 20°; in 6·8 mols. methyl, 10·6 mols. ethyl, and 14·6 mols. propyl alcohol at 38·2°. (Timofejew, C. R. **112**. 1224.)

100 pts. absolute methyl alcohol dissolve 66·9 pts. $HgCl_2$ at 25°; 100 pts. absolute ethyl alcohol dissolve 49·5 pts. $HgCl_2$ at 25°. (de Bruyn, Z. phys. Ch. **10**. 783.)

Sp. gr. of alcoholic solution of $HgCl_2$.

% $HgCl_2$	Sp. gr.			
	at 0°	at 10°	at 20°	at 30°
0·00	0·83135	0·82286	0·81435	0·80594
1·22	0·8397	0·8312	0·8228	0·8141
2·38	0·8484	0·8399	0·8314	0·8227
4·42	0·8635	0·8549	0·8463	0·8376
8·56	0·8966	0·8877	0·8789	0·8698
12·43	0·9306	0·9213	0·9119	0·9024
15·91	0·9629	0·9528	0·9425	0·9329
19·32	0·9951	0·9852	0·9753	0·9652
22·46	1·0285	1·0184	1·0083	0·9982

(Schröder, B. **19**. 161 R.)

Sol. in 4 pts. ether (Karls); in 4·1 pts. (Henry); in 2·86 pts. ether of 0·745 sp. gr. (sp. gr. of solution=1·08); the solvent power is not increased by elevating the temp., and b.-pt. of ether is not raised. (*J. Davy.*)

Ether extracts $HgCl_2$ from $HgCl_2$+Aq (Orfila); very slightly if $HgCl_2$+Aq is dil. (Lassaigne.)

Very sl. sol. in pure ether. (Follie, B. **20**. 717.)

4 pts. ether dissolve 1 pt. $HgCl_2$, but 4 pts. ether+1·33 pts. camphor dissolve 1·33 pts. $HgCl_2$; 4 pts. ether+4 pts. camphor dissolve 2 pts. $HgCl_2$; 4 pts. ether+8 pts. camphor dissolve 4 pts. $HgCl_2$; 4 pts. ether+16 pts. camphor dissolve 8 pts. $HgCl_2$. (Karls, Pogg. **10**. 608.)

3 pts. alcohol dissolve 1 pt. $HgCl_2$, but 3

pts. alcohol + 1 pt. camphor dissolve 2 pts. $HgCl_2$; 3 pts. alcohol + 3 pts. camphor dissolve 3 pts. $HgCl_2$; 3 pts. alcohol + 6 pts. camphor dissolve 6 pts. $HgCl_2$. (Karls, *l.c.*)

Solution can be obtained containing 25 pts. camphor, 16 pts. $HgCl_2$, and only 4 pts. alcohol. Sp. gr. of solution = 1·326. (Simon, Pogg. **37**. 553.)

Easily sol. in oil of turpentine and other essential oils; sl. sol. in cold benzene, but much more on heating, crystallising on cooling. (Franchimont, B. **16**. 387.)

Extracted from $HgCl_2$ + Aq by volatile oils.

Easily sol. in glycerine; sol. in 14 pts. glycerine. (Fairley, Monit. Scient. (3) **9**. 685.)

Easily sol. in boiling creosote.

Insol. in olive oil.

100 pts. acetone dissolve 60 pts. $HgCl_2$ at 25°. (Krug and M'Elroy, J. Anal. Appl. Ch. 184.)

Mercuric hydrogen chloride (**Chloromercuric acid**), $HgCl_2, HCl = HHgCl_3$.

Decomp. by H_2O. (Boullay, A. ch. **34**. 243.)

Easily decomposed. (Neumann, M. **10**. 236.)

$HgCl_2, 2HCl + 7H_2O$. Decomp. by H_2O. (Ditte, A. ch. (5) **22**. 551.)

$3HgCl_2, 4HCl + 14H_2O$. As above.

$2HgCl_2, HCl + 6H_2O$. As above.

$4HgCl_2, 2HCl + 9H_2O$. As above.

$3HgCl_2, HCl + 5H_2O$. As above.

Mercuric nickel chloride.

Deliquescent. (v. Bonsdorff.)

Mercuric nitrosyl chloride, $HgCl_2, NOCl$.

Sol. in H_2O without effervescence. (Sudborough, Chem. Soc. **59**. 659.)

Mercuric phosphoric chloride, $3HgCl_2, 2PCl_5$.

Decomp. and dissolved by H_2O. (Baudrimont, A. ch. (4) **2**. 45.)

Mercuric potassium chloride, $2HgCl_2, KCl + 2H_2O$.

Very easily sol. in warm H_2O. A clear solution at 18° is filled with crystals at 15°. Sl. sol. in alcohol. (v. Bonsdorff, Pogg. **17**. 122.)

$HgCl_2, KCl + H_2O$. Easily sol. in H_2O; sl. sol. in alcohol. (v. Bonsdorff, Pogg. **19**. 336.)

$HgCl_2, 2KCl + H_2O$. As above.

Mercurous rhodium chloride.

See **Chlororhodite, mercurous.**

Mercuric rubidium chloride, $HgCl_2, RbCl$.

Sol. in H_2O.

$HgCl_2, 2RbCl$. Sol. in H_2O and HCl + Aq. (Godeffroy, Arch. Pharm. (3) **12**. 47.)

$+ 2H_2O$. Sol. in H_2O. (Godeffroy.)

$2HgCl_2, RbCl$. Sol. in H_2O. (Godeffroy.)

Mercuric sodium chloride, $HgCl_2, NaCl + 1\frac{1}{2}H_2O$.

Sol. in 0·33 pt. H_2O at 15°. (Schindler, Repert. **36**. 240.)

Extremely easily sol. in alcohol. (Voit.)

Sol. in 275 pts. ether. Ether dissolves the undecomposed salt out of H_2O solution. (Lassaigne, A. ch. **64**. 104.)

$HgCl_2, 2NaCl$. Deliquescent. Very sol. in H_2O. (Voit, A. **104**. 354.)

Mercuric strontium chloride, $2HgCl_2, SrCl_2 + 2H_2O$.

Easily sol. in H_2O. (v. Bonsdorff.)

Mercuric strontium chloride, basic, $SrCl_2, HgO + 6H_2O$.

Decomp. by H_2O. (Andrè, C. R. **104**. 431.)

Mercurous sulphur chloride.

See **Mercurous sulphochloride.**

Mercuric thallous chloride, $HgCl_2, TlCl$.

Easily sol. in H_2O. (Jörgensen, J. pr. (2) **6**. 83.)

Mercurous stannous chloride, $Hg_2Cl_2, SnCl_2$.

Decomp. by H_2O. (Capitaine, J. Pharm. **25**. 549.)

Mercuric yttrium chloride, $3HgCl_2, YCl_3 + 9H_2O$.

Deliquescent. Very sol. in H_2O. (Popp, A. **131**. 179.)

Mercuric zinc chloride.

Very deliquescent. (v. Bonsdorff.)

Mercuric zinc chloride ammonia, $HgCl_2, 4ZnCl_2, 10NH_3 + 2H_2O$.

Insol. in boiling H_2O, but decomp. thereby. (Andrè, C. R. **112**. 995.)

$HgCl_2, 2ZnCl_2, 6NH_3 + \frac{1}{2}H_2O$. As above. (Andrè.)

Mercuric chloroiodide, $2HgCl_2, HgI_2$.

Sol. in H_2O. (Liebig.)

$HgCl_2, HgI_2$. Sl. sol. in hot H_2O with partial decomp. More easily sol. in alcohol. (Köhler, B. **12**. 1187.)

Mercurous fluoride, Hg_2F_2.

Decomp. by H_2O with separation of Hg_2O.

Mercuric fluoride, $HgF_2 + 2H_2O$.

Decomp. by cold H_2O, with separation of HgO. Sol. in dil. HNO_3 + Aq, and HF + Aq. (Finkener, Pogg. **110**. 628.)

Mercurous fluoride ammonia, $Hg_2F_2, 2NH_3$.

Stable on air. (Finkener, Pogg. **110**. 142.)

Mercurous iodamide, $Hg_2(NH_2)I$.

(Rammelsberg, Pogg. **48**. 184.)

Is a mixture of Hg and $Hg(NH_2)I$. (Barfoed.)

Mercurous iodide, Hg_2I_2.

Sol. in over 2375 pts. H_2O. (Saladin, J. chim. méd. **7**. 530.)

Sol. in $Hg(NO_3)_2$ + Aq. (Stromann, B. **20**. 2815.)

Sol. in KI + Aq. Easily sol. in $Hg_2(NO_3)_2$ + Aq. Sl. sol. in NH_4OH + Aq. Sol. in hot NH_4Cl + Aq, but less than HgI_2. Less sol. in NH_4NO_3 than in NH_4Cl + Aq. (Brett.)

Partially sol. with separation of Hg and formation of HgI_2, in cold KI + Aq, hot NaI, CaI_2, SrI_2, BaI_2, MgI_2, ZnI_2, and NH_4I + Aq; in warm NaCl, KCl, and NH_4Cl + Aq, and slowly in hot HCl + Aq. (Boullay, A. ch. (2) **34**. 358.)

Decomp. by alkali chlorides + Aq. (Miahle, A. ch. (3) **5**. 177.)

Not wholly insol. in alcohol, ether, or chloroform. (Maclagan, Rep. anal. Ch. **1884**. 378.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3**. 345.)

Mercuric iodide, HgI_2.

Sol. in 150 (?) pts. H_2O. (Würtz.)

1 l. H_2O at 17·5° dissolves 0·0403 g. HgI_2. (Bourgoin, A. ch. (6) **3**. 429.)

Sol. in about 6500 pts. H_2O. (Hager.)

According to calculation from electrical conductivity of HgI_2 + Aq, HgI_2 is much less sol., 1 l. H_2O dissolving only 0·5 mg. HgI_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Sol. in many acids, especially in HCl, and HI + Aq. Insol. in $HC_2H_3O_2$ + Aq. (Berthemot.) Scarcely sol. in dil. HNO_3 + Aq.

Sol. in hot $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, cold NH_4Cl, NH_4NO_3, or ammonium succinate + Aq. (Wittstein.)

Sol. in $HgCl_2$, $Hg(NO_3)_2$, or $Hg(C_2H_3O_2)_2$ + Aq. Easily sol. in $Na_2S_2O_3$ + Aq. Easily sol. in soluble iodides + Aq. More sol. in hot than in cold NaI or KI + Aq. When conc. 1 mol. KI in hot solution dissolves 3 mols. HgI_2, but a portion separates on cooling. BaI_2, SrI_2, MgI_2, and CaI_2 act in the same way. Easily sol. in cold, more sol. in hot ZnI_2 + Aq, 2 mols. HgI_2 being dissolved to 1 mol. ZnI_2. In NH_4I + Aq, 3 mols. HgI_2 are dissolved to 2 mols. NH_4I. Abundantly sol. in hot KCl, NaCl, NH_4Cl + Aq, but separates out on cooling, and the trace remaining may be pptd. by H_2O, 2 g. KCl in solution dissolves 1·166 g. HgI_2. Sol. in $HgCl_2$ + Aq, and very easily sol. in alcoholic solution of $HgCl_2$. (Boullay, A. ch. (2) **34**. 346.)

Sol. in $Sb(CH_3)_4I$ + Aq. Very sl. sol. in Na citrate + Aq. (Spiller.)

Sol. in $Ca(OCl)_2$ + Aq; sol. in KOH + Aq. (Melsens, A. ch. (3) **26**. 222.)

More sol. in alcohol than in H_2O. 1 l. H_2O containing 10 % of 90 % alcohol dissolves 0·08 g. HgI_2. 1 l. of alcohol of 80° B. dissolves 2·851 g. HgI_2, 1 l. absolute alcohol dissolves 11·86 g. HgI_2. (Bourgoin, A. ch. (6) **3**. 429.)

Sol. in 130 pts. cold, and 15 pts. hot 90 % alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 3·16 pts. at 19·5°; 100 pts. absolute ethyl alcohol dissolve 2·09 pts. at 19·5°. (de Bruyn, Z. phys. Ch. **10**. 783.)

100 pts. acetone dissolve 2·09 pts. HgI_2 at 25°. (Krug and M'Elroy, J. Anal. Ch. **6**. 84.)

Sol. in CS_2, and somewhat in ether. Sol. in 77 pts. ether. (Saladin.) Sol. in 60 pts. ether. (Hager.)

Sol. in 340 pts. glycerine. (Fairley, Monit. Scient. (3) **9**. 685.)

1000 pts. oil of bitter almonds dissolve 4 pts. HgI_2 at ord. temp.; 1000 pts. olive oil, 4 pts.; 1000 pts. poppy oil, 10 pts.; 1000 pts. nut oil, 15 pts.; 1000 pts. castor oil, 20 pts.; 1000 pts. lard oil, 4·5 pts.; 1000 pts. vaseline, 2·5 pts.; 1000 pts. benzene, 4 pts. Sol. in phenole. (Mehn, Pharm. J. **3**. 327; B. **19**. 8 R.)

Sol. in hot acetic anhydride. (Rosenfeld, B. **13**. 1475.)

Sol. in hot caoutchine.

Sol. in warm caprylene.

100 pts. methylene iodide CH_2I_2 dissolve 2·5 pts. HgI_2 at 15°, 16·6 pts. at 100°, and 58 pts. at 180°. (Retgers, Z. anorg. **3**. 252.)

Min. *Coccinite.*

Mercuromercuric iodide, $Hg_4I_6 = Hg_2I_2, 2HgI_2$.

Insol. in H_2O or alcohol. Partially sol. in KI + Aq, in hot NaCl, and NH_4Cl + Aq, and in hot HCl + Aq, though very slowly. (Boullay, A. ch. (2) **34**. 345.

Mercury *per*iodide, HgI_6.

Sol. in KI + Aq. Decomp. by cold H_2O or alcohol. (Jörgensen, J. pr. (2) **2**. 347.)

Mercuric hydrogen iodide (Iodomercuric acid), HI, $HgI_2 = HHgI_3$.

Crystallises from HI + Aq. (Boullay.)

Easily decomp. (Neumann, M. **10**. 236.)

Mercuric potassium iodide, HgI_2, KI + $1\frac{1}{2}H_2O$.

Deliquescent (v. Bonsdorff). Permanent; decomp. by H_2O into 2KI, HgI_2, and HgI_2 (Boullay); sol. in alcohol, ether, and conc. $HC_2H_3O_2$, but decomp. by other acids (Berthemot, J. Pharm. **14**. 186). Sp. gr. of sat. solution in H_2O = 2·4 to 3·1.

HgI_2, 2KI. Sol. in H_2O. (Thomsen and Bloxam, Chem. Soc. **41**. 379.)

Mercuric sodium iodide, HgI_2, NaI.

Deliquescent, and decomp. by much H_2O. (v. Bonsdorff, Pogg. **17**. 266.)

Sol. in alcohol and ether.

HgI_2, 2NaI. Deliquescent; sol. in H_2O and alcohol. (Boullay.)

Mercuric strontium iodide, HgI_2, SrI_2 (?).

Sol. in H_2O without decomp. (Boullay.)

$2HgI_2$, SrI_2 (?). Decomp. by much H_2O into sol. HgI_2, SrI_2 and insol. HgI_2. (Boullay.)

Mercuric zinc iodide.

Deliquescent. Decomp. by H_2O. (v. Bonsdorff.)

Mercuric iodide silver chloride, HgI_2, 2AgCl.

Insol. in H_2O. (Lea, Sill. Am. J. (3) **7**. 34.)

Mercury nitride, Hg_3N_2.

Gradually decomp. by H_2O. Decomp. by conc. HNO_3, or HCl + Aq. (Hirzel, J. B. **1852**. 419.)

Not attacked by cold, but decomp. by hot dil. H_2SO_4.

Mercurous oxide, Hg_2O.

Insol. in H_2O. Insol. in dil. HCl or HNO_3 + Aq. Sol. in warm conc. $HC_2H_3O_2$ + Aq.

Decomp. by H_2O or weak bases (Rose), $(NH_4)_2CO_3$ + Aq (Wittstein), KNO_3 + Aq (Rose), KI + Aq (Berthemot), or conc. NH_4Cl + Aq (Pagenstecher) into HgO and Hg, or $HgCl_2$, etc.

Sl. decomp. by alkali chlorides + Aq with formation of $HgCl_2$, which dissolves. (Miahle.)

Sl. sol. in alkali cyanides + Aq. (Jahn.)

Insol. in KOH, and NaOH + Aq.

Insol. in alcohol and

Mercuric oxide, HgO.

Sol. in 20,000 to 30,000 pts. H_2O. (Bineau, C. R. **41**. 509.)

Sol. in 200,000 pts. H_2O. (Wallace, Ch. Gaz. **1858**. 345.)

Sol. in acids. Insol. in H_3PO_4 or H_3AsO_4 + Aq. (Haack, A. **262**. 190.)

Scarcely attacked by $H_2C_2O_4$ + Aq. (Millon, A. ch. (3) **18**. 352.)

Sol. in hot NH_4Cl + Aq, less in NH_4NO_3 + Aq. (Brett.)

Insol. in KOH, or NaOH + Aq.

Decomp. by alkali chlorides + Aq into $HgCl_2$, which dissolves. (Miahle, A. ch. (3) **5**. 177.)

Sol. in $Fe(NO_3)_3$, and $Bi(NO_3)_3$ + Aq with pptn. of oxides. Sol. in KI + Aq. (Persoz.)

Insol. in alcohol.

Mercuric oxybromide, $HgBr_2$, HgO.

(André, A. ch. (6) **3**. 123.)

$HgBr_2$, $2HgO$. (André.)

$HgBr_2$, $3HgO$. (*a*) *Yellow*. Insol. in cold, sl. sol. in hot H_2O. Easily sol. in alcohol. (Löwig.)

(*b*) *Brown*. Insol. in alcohol. (Rammelsberg, Pogg. **55**. 248.)

$HgBr_2$, $4HgO$. (André.)

Mercuric oxychloride, HgO, $2HgCl_2$.

Decomp. by warm H_2O or cold alcohol into $2HgO$, $HgCl_2$. (Thümmel, Arch. Pharm. (3) **27**. 589.)

HgO, $HgCl_2$. Less sol. than $HgCl_2$, but not isolated. (Thümmel.) Decomp. by cold H_2O. (Andrè, A. ch. (6) **3**. 118.)

$2HgO$, $HgCl_2$. (*a*) Insol. in H_2O; decomp. by alkali carbonates, or chlorides + Aq into $4HgO$, $HgCl_2$.

(*b*) Not decomp. by alkali chlorides, or carbonates + Aq. (Thümmel.)

$3HgO$, $HgCl_2$. Decomp. by warm H_2O. (Thümmel.)

Not attacked by cold H_2O. (André.)

$4HgO$, $HgCl_2$. (*a*) Not decomp. by cold, but by much hot H_2O.

(*b*) Not decomp. by hot H_2O.

$5HgO$, $HgCl_2$. (Millon.)

Does not exist. (Thümmel.)

$6HgO$, $HgCl_2$. Does not exist. (T.)

$+ H_2O$. Insol. in cold H_2O. (Roucher, A. ch. (3) **27**. 353.)

Does not exist. (T.)

$7HgO$, $4HgCl_2$. (Roucher.)

Does not exist. (T.)

Mercuric oxyfluoride, HgO, $HgF_2 + H_2O$.

Decomp. by H_2O. Sol. in dil. HNO_3 + Aq. (Finkener.)

Mercuric strontium oxychloride, HgO, $SrCl_2 + 6H_2O$.

Decomp. by H_2O. (André, C. R. **104**. 431.)

Mercuric oxyiodide, $3HgO$, HgI_2.

Decomp. by H_2O. Sol. in HI + Aq. (Weyl, Pogg. **131**. 524.)

Mercuric oxyselenide, $2HgSe$, HgO.

Easily sol. in aqua regia. (Uelsmann, A. **116**. 122.)

Mercury phosphide, Hg_3P_2.

Insol. in H_2O, HNO_3, or HCl + Aq. Easily sol. in aqua regia. (Granger, C. R. **115**. 229.)

Mercury phosphochloride, P_2Hg_3, $3HgCl_2 + 3H_2O$.

See *Di***mercuriphosphonium mercuric chloride.**

Mercury phosphosulphide, $2HgS$, P_2S.

HgS, P_2S.
$2HgS$, P_2S_3. (Berzelius.)
$3HgS$, P_2S_3. (Baudrimont, C. R. **55**. 323.)
$2HgS$, P_2S_5. (Berzelius, A. **46**. 256.)

Mercuric selenide, $HgSe$.

Sol. in cold aqua regia when crystalline. When precipitated shows the same properties towards solvents as mercuric sulphide. (Reeb, J. Pharm. (4) **9**. 173.)

Min. *Tilmannite*. Sol. only in aqua regia.

Mercuric selenochloride, $2HgSe$, $HgCl_2$.

Insol. in boiling HCl, HNO_3, or H_2SO_4 + Aq. Easily sol. in aqua regia and a mixture of H_2SO_4 and conc. HNO_3 + Aq. (Uelsmann, J. B. **1860**. 92.)

Mercurous sulphide, Hg_2S.

Insol. in H_2O, dil. HNO_3, hot NH_4OH, or $(NH_4)_2S$ + Aq. Sol. in KOH + Aq with separation of Hg. (Rose.)

Does not exist; only mixtures of Hg and HgS are formed. (Barfoed, J. pr. **93**. 230.)

Mercuric sulphide, HgS.

Insol. in H_2O.

Pptd. as a brown coloration in presence of 20,000 pts. H_2O, and as a green coloration in presence of 40,000 pts. H_2O. (Lassaigne.)

Sol. in cold conc., and in hot dil. HI + Aq or HBr + Aq. (Kekulé, A. Suppl. **2**. 101.) Very sl. decomp. by hot conc. HCl + Aq. Not attacked by hot HNO_3 + Aq. Sol. in cold aqua regia.

Sol. in K_2S + Aq, but readily only in presence of free alkali. (Brunner, Pogg. **15**. 596.) Insol. in boiling KOH + Aq.

Sol. in KSH or NaSH + Aq. Very sl. sol. in cold yellow $(NH_4)_2S$ + Aq. Insol. in KCN or $Na_2S_2O_3$ + Aq. (Fresenius.)

Easily sol. in conc. Na_2S or K_2S + Aq, even in absence of KOH or NaOH. Insol. in $(NH_4)_2S$ + Aq. Sol. in CaS, BaS, or SrS + Aq. Insol. in NaSH or KSH + Aq. (de Koninck, Z. angew. Ch. **1891**. 51.)

Sol. in potassium thiocarbonate + Aq. (Rosenbladt, Z. anal. **26**. 15.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. **16**. 2015.)

1 l. BaS_2H_2 + Aq containing 50 g. Ba dissolves no HgS in the cold, but 50-60 g. at 40-50°.

Exists in a colloidal state, sol. in H_2O. (Winnsinger, Bull. Soc. (2) **49**. 452.)

Min. *Cinnabar*. Insol. in H_2O, alcohol, dil. acids, or alkaline solutions.

Decomp. by hot dil. HNO_3 + Aq. Not decomp. by HCl + Aq, but easily by hot H_2SO_4

or aqua regia. Easily sol. in $CuCl_2$+Aq. (Karsten.)

Sol. in a mixture of Na_2S and NaOH when present in the proportion of HgS : $2Na_2S$.

Sol. in pure Na_2S+Aq or in mixtures of Na_2S and NaSH+Aq. Insol. in cold NaSH+Aq, but sol. on warming with evolution of H_2S. (Becker, Sill. Am. J. (3) **33**. 199.)

Insol. in acetone. (Krug and M'Elroy.)

Mercuric platinum sulphide.

See **Sulphoplatinate, mercuric.**

Mercuric potassium sulphide, K_2S, 2HgS.

Decomp. into its constituents by H_2O; decomp. by HCl, and HNO_3+Aq, and by hot KOH, and NH_4OH+Aq. (Schneider, Pogg. **127**. 488.)

K_2S, HgS + $5H_2O$. Decomp. by H_2O or alkalies. (Weber, Pogg. **97**. 76.)

+H_2O. (Ditte.)

+$7H_2O$. Sol. in K_2S+Aq. (Ditte, C. R. **98**. 1271.)

K_2S, 5HgS+$5H_2O$. Easily decomp. by H_2O. (Ditte.)

Mercuric sodium sulphide, HgS, Na_2S+8H_2O.

Decomp. by H_2O or alkalies.

Mercuric sulphobromide, 2HgS, $HgBr_2$.

Insol. in H_2O. Not attacked by boiling HNO_3 or H_2SO_4. (Rose.)

Mercuric sulphochloride, 2HgS, $HgCl_2$.

Insol. in H_2O, cold or hot, dil. or conc. HNO_3, H_2SO_4, or HCl+Aq. (Rose, Pogg. **13**. 59.)

Decomp. by hot aqua regia.

3HgS, $HgCl_2$. Properties as the above comp. (Poleck and Goercki, B. **21**. 2415.)

4HgS, $HgCl_2$. As above. (P. and G.)

5HgS, $HgCl_2$. As above. (P. and G.)

Mercurous sulpho*tetra*chloride, Hg_2SCl_4.

Decomp. by H_2O with separation of S, $HgCl_2$ going into solution. (Capitaine, J. Pharm. **25**. 525.)

Mercuric sulphofluoride, 2HgS, HgF_2.

Decomp. by boiling H_2O. Not decomp. by hot HCl or HNO_3+Aq, but gives HF with hot H_2SO_4+Aq. (Rose, Pogg, **13**. 66.)

Mercuric sulphoiodide, HgS, HgI_2.

Ppt. (Rammelsberg, Pogg. **48**. 175.)

2HgS, HgI_2. (Palm, C. C. **1863**. 121.)

Mercuric telluride, HgTe.

Min. *Coloradoite.* Sol. in boiling HNO_3+Aq with separation of H_2TeO_3.

Metastannic acid.

See **Stannic acid.**

Molybdatoiodic acid.

See **Molybdoiodic acid.**

Molybdenum, Mo.

Not attacked by HCl, HF, or dil. H_2SO_4+Aq. Sol. in conc. H_2SO_4. Very easily sol. in aqua regia. Oxidised by HNO_3+Aq either to molybdenum oxide, which dissolves in HNO_3, or, if HNO_3 is in excess, to molybdic acid, which remains undissolved.

Attacked by HNO_3+Aq containing 3-70 % HNO_3, but only slowly by 70 % acid, with formation of insol. white powder; much more vigorously by 50 % acid, in which case a clear solution is formed. (Montemartini, Gazz. ch. it. **22**. 384.)

Not attacked by alkalies+Aq. (Bucholz, Scher. J. **9**. 485.)

Molybdenum acichloride.

See **Molybdenyl chloride.**

Molybdenum amide nitride, $Mo_5N_{10}H_4$ = $4MoN_2$, $Mo(NH_2)_2$.

Not attacked by HCl, or dil. HNO_3+Aq. (Uhrlaub.)

Molybdenum *di*bromide, $MoBr_2=Mo_3Br_4Br_2$.

See **Bromomolybdenum bromide.**

Molybdenum *tri*bromide, $MoBr_3$.

Not decomp. by H_2O. Boiling conc. HCl, and cold dil. HNO_3+Aq do not attack appreciably. Dil. alkalies act slowly, but decomp. with separation of Mo_2O_3 on boiling. (Blomstrand, J. pr. **82**. 435.)

Molybdenum *tetra*bromide, $MoBr_4$.

Rapidly deliquescent, and easily sol. in H_2O. (Blomstrand, J. pr. **82**. 433.)

Molybdenum bromochloride, etc.

See **Bromomolybdenum chloride, etc.**

Molybdenum *di*chloride, $MoCl_2=Mo_3Cl_4Cl_2$.

See **Chloromolybdenum chloride.**

Molybdenum *tri*chloride, $MoCl_3$.

Insol. in H_2O or boiling conc. HCl+Aq. Easily sol., especially when heated, in HNO_3+Aq. Sol. in H_2SO_4. Decomp. by NH_4OH, KOH, or NaOH+Aq.

Sl. sol. in alcohol. (Liechti and Kempe.)

Molybdenum *tetra*chloride, $MoCl_4$.

Deliquescent. Hisses with little H_2O, but only partly sol. in more H_2O. Only sl. sol. in conc. HCl+Aq. Sol. in H_2SO_4 or HNO_3+Aq. Partly sol. in alcohol and ether. (Liechti and Kempe.)

Molybdenum *penta*chloride, $MoCl_5$.

Very deliquescent. Sol. in H_2O with extreme evolution of heat. Sol. in HCl, HNO_3, or H_2SO_4+Aq.

Sol. in absolute alcohol or ether. (Liechti and Kempe.)

Molybdenum hydroxyl chloride, $Mo(OH)_2Cl_2$.

Easily sol. in H_2O. (Debray, C. R. **46**. 1101.)

Molybdenum *tri*chloride potassium chloride.

Efflorescent. Decomp. with H_2O. (Berzelius.)

Molybdenum *tetra*chloride phosphorus *penta*chloride, $MoCl_4$, PCl_5.

Sol. in H_2O.

$MoCl_4$, $2PCl_5$. Sol. in H_2O. (Cronander, Bull. Soc. (2) **19**. 500.)

Molybdenum phosphoryl chloride, $MoCl_5$, $POCl_3$.

Decomp. by H_2O; insol. in CS_2; sol. in C_6H_6 and $CHCl_3$.

Molybdenum fluoride.

No solid fluoride of molybdenum is known.

Molybdenum potassium *tri*fluoride (?).

Precipitate. Sol. in HCl+Aq.

Molybdenum potassium *tetra*fluoride (?).

Sl. sol. in H_2O. (Berzelius.)

Molybdenum *sesqui*hydroxide, $Mo_2O_6H_6$.

Difficultly sol. in acids. Insol. in KOH, NaOH, NH_4OH, or K_2CO_3+Aq. Somewhat sol. in $(NH_4)_2CO_3$+Aq, but pptd. on boiling. (Berzelius.)

Molybdenum hydroxide, Mo_3O_8, $5H_2O$.

Easily sol. in H_2O. Insol. in $CaCl_2$, NH_4Cl, or NaCl+Aq. Sl. sol. in alcohol. (Berzelius.)

Molybdenum *di*hydroxide, MoO_2, xH_2O.

Slowly and not abundantly sol. in H_2O, from which it is precipitated by NH_4Cl and other salts. Gelatinises by standing in closed vessels or by evaporating on the air. Sol. in the ordinary acids. Insol. in KOH, or NaOH+Aq. Sol. in alkali carbonates+Aq.

Molybdenum *tetra*iodide (?).

Completely sol. in water. (Berzelius.)

Molybdenum nitride, Mo_5N_3, and Mo_5N_4.

(Uhrlaub.)

See **Molybdenum amide.**

Molybdenum *mon*oxide, MoO.

Known only as hydroxide. (Blomstrand, J. pr. **77.** 90.)

Molybdenum *sesqui*oxide, Mo_2O_3.

Insol. in acids or alkalies.

See **Molybdenum *sesqui*hydroxide.**

Molybdenum oxide, Mo_5O_{12}.

Not attacked by ammonia; easily oxidised by HNO_3+Aq. Not attacked by HCl or H_2SO_4+Aq. (Wöhler, A. **110.** 275.)

Formula is Mo_3O_8, according to Wöhler, but Muthmann (A. **238.** 108) has shown that correct formula is Mo_5O_{12}.

Not attacked by boiling alkalies, HCl, or dil. H_2SO_4+Aq. Sol. in conc. H_2SO_4, with subsequent decomp. Sol. in aqua regia, and Cl_2+Aq. (Muthmann.)

Mo_3O_8. Sol. in H_2O. (Muthmann, A. **238.** 108.)

Min. *Ilsemannite* (?).

Mo_5O_7. (v. d. Pfordten, B. **15.** 1925.)

Molybdenum *di*oxide, MoO_2.

Insol. in HCl or HF+Aq. Sl. sol. in conc. H_2SO_4. HNO_3 oxidises to MoO_3. Not attacked by KOH+Aq. (Ullik, A. **144.** 227.)

Sl. sol. in $KHC_4H_4O_6$+Aq.

Molybdenum *tri*oxide, MoO_3.

Sol. in 500 pts. cold, and much less hot H_2O. (Bucholz.)

Sol. in 960 pts. hot H_2O. (Hatchett.)

Sol. in 570 pts. cold, and much less hot H_2O (Dumas.)

Sol. in acids before ignition. Insol. in acids, but sl. sol. in acid potassium tartrate+Aq after ignition. Sol. in alkalies or alkali carbonates+Aq.

Sol. in NH_4OH+Aq.

See also **Molybdic acid.**

Min. *Molybdite.* Sol. in HCl+Aq.

Molybdenum oxybromide.

See **Molybdenyl bromide.**

Molybdenum oxychloride.

See **Molybdenyl chloride.**

Molybdenum oxyfluoride.

See **Molybdenyl fluoride.**

Molybdenum oxyfluoride *with* MF.

See **Fluoxymolybdate, M,** *and* **Fluoxyhypomolybdate, M.**

Molybdenum phosphide, Mo_2P_2.

Gradually sol. in hot HNO_3+Aq. (Wöhler and Rautenberg, A. **109.** 374.)

Molybdenum selenide, $MoSe_3$.

Not obtained pure. (Uelsmann, A. **116.** 125.)

Molybdenum *di*sulphide, MoS_2.

Insol. in H_2O. Easily sol. in aqua regia. Easily oxidised by HNO_3. Sol. in boiling H_2SO_4. Sl. attacked by KOH+Aq. (Berzelius.)

Min. *Molybdenite.* Sol. in HNO_3+Aq, with separation of MoO_3; sol. in aqua regia; very sl. sol. in H_2SO_4.

Molybdenum *tri*sulphide, MoS_3.

Somewhat sol. in H_2O, especially if hot, but pptd. by an acid. Difficultly sol. except when boiled with KOH+Aq. Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides+Aq; slowly sol. in alkalies or alkali hydrosulphides+Aq. (Atterberg, J. B. **1873.** 258.)

Molybdenum *tetra*sulphide, MoS_4.

Not decomp. by hot H_2O or acids.

Sl. sol. in cold alkali sulphides+Aq, but easily by boiling. (Berzelius.)

Molybdenum sulphide *with* MS.

See **Sulphomolybdate, M.**

Molybdenyl bromide, MoO_2Br_2.

Deliquescent, and sol. in H_2O with slight evolution of heat.

$Mo_2O_3Br_4$. Unstable in air. (Smith and Oberholtzer, Z. anorg. **4.** 236.)

Molydenyl chloride, MoO_2Cl_2.

Sol. in H_2O and alcohol.

$MoOCl_4$. Deliquescent. Sol. in little H_2O with violent action. More H_2O decomposes. (Püttbach, A. **201.** 123.)

Formula is $Mo_9O_8Cl_{32}$, according to Blomstrand (J. pr. **71.** 460).

$Mo_2O_3Cl_4$. (Püttbach, *l.c.*)

$Mo_2O_3Cl_6$. Deliquescent. Sol. in H_2O with very slight evolution of heat and subsequent formation of precipitate. (Blomstrand.)

Sol. in acids. (Püttbach, A. **201**. 129.)

$Mo_2O_3Cl_5$. Deliquescent, and sol. in H_2O. (Blomstrand.)

$Mo_3O_5Cl_8$. Insol. in HCl and cold H_2SO_4. Sol. in hot H_2SO_4 and HNO_3. (Püttbach, A. **201**. 123.)

$Mo_3O_4Cl_7$. Difficultly sol. in HCl. Easily sol. in HNO_3, and alkalies + Aq. (Püttbach.)

Molybdenyl fluoride, MoO_2F_2.

Decomp. rapidly in moist air. (Schulze, J. pr. (2) **21**. 442.)

$Mo_2O_3F_4$. Deliquescent. Easily sol. in HF + Aq, not in H_2O. (Smith and Oberholtzer.)

Molybdenyl fluoride *with* **MF.**

See **Fluoxymolybdate, M,** *and* **Fluoxyhypomolybdate, M.**

Molybdic acid, H_2MoO_4.

(Ullik, A. **144**. 217.)

Nearly insol. in H_2O. (Vivier, C. R. **106**. 601.)

H_4MoO_5. Sol. in H_2O and acids. (Millingk.)

H_6MoO_6 (?). Known only in solution.

$H_2Mo_2O_7$. Easily sol. in H_2O. (Ullik.)

$H_2Mo_4O_{13}$. Easily sol. in H_2O. (U.)

$H_2Mo_8O_{25}$. Easily sol. in H_2O. (U.)

Molybdic acid also exists in a colloidal modification, sol. in H_2O. (Graham, C. R. **59**. 174.)

Molybdates.

The normal molybdates of the alkali metals are easily sol. in H_2O, while the others are sl. sol. or insol. therein.

The *tri*molybdates are sl. sol. in cold, but very easily sol. in hot H_2O.

The *tetra*molybdates are easily sol. in H_2O.

Aluminum molybdate, $Al_{10}Mo_2O_{21}$.

Precipitate. (Gentele, J. pr. **81**. 414.)

Contains aluminum hydroxide and sulphate. (Struve, J. pr. **61**. 441.)

Aluminum ammonium molybdate, Al_2O_3, $3(NH_4)_2O$, $12MoO_3+20H_2O$.

More sol. in H_2O than aluminum potassium molybdate. (Struve, Bull. Acad. St. Petersb. **12**. 147.)

Aluminum potassium molybdate, $3K_2O$, Al_2O_3, $12MoO_3+20H_2O$.

1 pt. of the salt is sol. in 40·67 pts. H_2O at 17°. Very difficultly sol. in acids. (Struve.)

$H_3Al(MoO_4)_3$, $2KHMoO_4$. Sol. in H_2O. (Parmentier, C. R. **94**. 1713.)

Aluminum sodium molybdate, Al_2O_3, $3Na_2O$, $12MoO_3+22H_2O$.

Efflorescent. Easily sol. in H_2O. (Gentele, J. pr. **81**. 413.)

Ammonium molybdate, $(NH_4)_2MoO_4$.

Efflorescent through loss of NH_3; decomp. by H_2O into acid salt. (Svanberg and Struve.)

Ammonium *di***molybdate,** $(NH_4)_2Mo_2O_7$.

Sol. in H_2O.

$+H_2O=NH_4HMoO_4$. Sol. in H_2O. Sol. in 2-3 pts. H_2O. (Brandes; Mauro, Gazz. ch. it. **18**. 120.)

Ammonium *tri***molybdate,** $(NH_4)_2Mo_3O_{10}+H_2O$.

Very difficultly sol. in cold, easily sol. in hot H_2O. (Berlin, J. pr. **49**. 445.)

Easily sol. in NH_4OH + Aq. (Kämmerer, J. pr. (2) **6**. 358.)

Ammonium *tetra***molybdate,** $(NH_4)_2Mo_4O_{13}+2H_2O$.

Very difficultly sol. in cold, rather easily in hot H_2O. (Berlin.)

Ammonium *penta***molybdate,** $(NH_4)_4Mo_5O_{17}+H_2O$.

(Jean, C. R. **78**. 436.)

Ammonium *hepta***molybdate,** $(NH_4)_6Mo_7O_{24}+4H_2O$.

Not efflorescent. Sol. in H_2O. (Delafontaine, N. Arch. Sc. ph. nat. **23**. 17.)

According to Struve and Berlin = $(NH_4)_4Mo_5O_{17}+3H_2O$.

According to Marignac and Delffs = $(NH_4)HMoO_4$.

$+12H_2O$. More sol. than the above. (Rammelsberg, Pogg. **127**. 298.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. **6**. 184.)

Ammonium chromic molybdate, $3(NH_4)_2O$, Cr_2O_3, $12MoO_3+20H_2O=3(NH_4)_2Mo_2O_7$, $Cr_2(Mo_2O_7)_3+20H_2O$.

Sol. in H_2O. (Struve, J. pr. **61**. 457.)

Ammonium cupric molybdate, $(NH_4)_2O$, CuO, $5MoO_3+9H_2O$.

Sl. sol. in cold, sol. in boiling H_2O without decomp. (Struve.)

Ammonium ferric molybdate, $3(NH_4)_2Mo_2O_7$, $Fe_2(MoO_4)_6+20H_2O$.

Sol. in H_2O. (Struve.)

Ammonium magnesium molybdate, $(NH_4)_2O$, MgO, $2MoO_3+2H_2O=(NH_4)_2MoO_4$, $MgMoO_4+2H_2O$.

Easily sol. in H_2O. (Ullik, A. **144**. 344.)

Ammonium manganic molybdate, $5(NH_4)_2MoO_4$, $Mn_2(Mo_2O_7)_3+12H_2O$.

Permanent; sol. in 102 pts. H_2O at 17°. (Struve, J. pr. **61**. 460.)

Ammonium mercuric molybdate.

Sol. in HCl + Aq. Sol. in boiling NH_4Cl + Aq, separating out on cooling. Sol. in hot $(NH_4)_2SO_3$ + Aq. (Hirzel.)

Ammonium molybdenum molybdate, $(NH_4)_2O$, $2MoO_2$, $4MoO_3+9H_2O$.

Easily sol. in H_2O, but the solution soon becomes cloudy. (Rammelsberg, Pogg. **127**. 291.)

Ammonium sodium molybdate, $7(NH_4)_2O$, $2Na_2O$, $21MoO_3+15H_2O$ (?).

Easily sol. in H_2O. (Delafontaine, J. pr. **95**. 136.)

$7(NH_4)_2O$, $3Na_2O$, $25MoO_3+30H_2O$ (?). (Delafontaine.)

$(NH_4Na)O$, $3MoO_3+H_2O$. Sol. in H_2O. (Mauro, Gazz. ch. it. **11**. 214.)

Ammonium zinc molybdate.

Sol. in H_2O. (Berzelius.)

Ammonium molybdate hydrogen *di*oxide, $18MoO_3, 7(NH_4)_2O, 3H_2O_2+11H_2O$.

Sol. in H_2O. (Bärwald, B. **17**. 1206.)

Barium molybdate, basic, $2BaO, MoO_3+H_2O$ (?).

Insol. in H_2O. Sol. in dil. $HCl+Aq$ or HNO_3+Aq. (Heine, J. pr. **9**. 204.)

Barium molybdate, $BaMoO_4$.

Difficultly sol. in H_2O; sol. in dil. HCl, and HNO_3+Aq. (Svanberg and Struve.)

Sol. in 17,200 pts. H_2O at 23°. More sol. in NH_4NO_3+Aq than in H_2O. (Smith and Bradbury, B. **24**. 2930.)

Barium *tri*molybdate, $BaMo_3O_{10}+3H_2O$.

Sl. sol. in H_2O.

Barium *hepta*molybdate, $Ba_3Mo_7O_{24}+9H_2O$.

Appreciably sol. in H_2O. (Jörgensen.)

According to Svanberg and Struve = $Ba_2Mo_5O_{17}+6H_2O$.

Barium *nono*molybdate, $BaMo_9O_{28}+4H_2O$.

Insol. in cold or hot H_2O or HNO_3+Aq. Extremely slightly decomp. by H_2SO_4, or $H_2SO_4+HNO_3$, or $HCl+Aq$. (Svanberg and Struve.)

Barium hydrogen *tetra*molybdate, $BaH_2(Mo_4O_{13})_2+17H_2O$.

Insol. in cold, apparently decomp. by hot H_2O, a small part dissolving, and the rest forming an insol. residue. (Ullik, A. **144**. 336.)

Barium molybdate hydrogen *di*oxide, $8BaO, 19MoO_3, 2H_2O_2+13H_2O$.

Precipitate. (Bärwald.)

Bismuth molybdate, $Bi_2O_3, 3MoO_3$.

Somewhat sol. in H_2O. Sol. in 500 pts. H_2O and in the stronger acids. (Richter.)

Bromomolybdenum molybdate.

See under **Bromomolybdenum comps.**

Cadmium molybdate, $CdMoO_4$.

Insol. in H_2O; sol. in NH_4OH+Aq, $KCN+Aq$, or acids. (Smith and Bradbury, B. **24**. 2390.)

Calcium molybdate, $CaMoO_4$.

Insol. precipitate. (Ullik.)

Sl. sol. in H_2O; insol. in alcohol. (Smith and Bradbury, B. **24**. 2930.)

Calcium *tri*molybdate, $CaMo_3O_{10}+6H_2O$.

Difficultly sol. in cold, easily in hot H_2O. (Ullik, A. **144**. 231.)

Calcium *tetra*molybdate, $CaMo_4O_{13}+9H_2O$.

Easily sol. in cold H_2O.

Calcium hydrogen *tetra*molybdate, $CaH_2(Mo_4O_{13})_2+17H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O with decomp. (Ullik.)

Cerium molybdate, $Ce_2(MoO_4)_3$.

Precipitate. Insol. in H_2O; sol. in acids. (Cossa, B. **19**. 536 R.)

Chromic molybdate.

Insol. in H_2O, but sol. in acids. Sol. in NH_4 molybdate $+Aq$. (Berzelius.)

Chromic potassium molybdate, $3K_2O, Cr_2O_3, 12MoO_3+20H_2O=3K_2Mo_2O_7, Cr_2(Mo_2O_7)_3+20H_2O$.

Sol. in 38·51 pts. H_2O at 17°. (Struve.)

Chromic sodium molybdate, $3Na_2O, Cr_2O_3, 12MoO_3+21H_2O$.

Efflorescent. Easily sol. in H_2O.

Cobaltous molybdate, $CoMoO_4$.

Decomp. by alkalies and strong acids. (Berzelius.)

$+H_2O$. Sl. sol. in pure, easily sol. in acidified H_2O. (Coloriano, Bull. Soc. (2) **50**. 451.)

Cobaltous *tri*molybdate, $CoMo_3O_{10}+10H_2O$.

Very sl. sol. in cold, but very easily sol. in hot H_2O. (Ullik, W. A. B. **55**, **2**. 767.)

Cobaltic potassium molybdate, $Co_2O_3, 3K_2O, 12MoO_3+2H_2O$.

Sol. in H_2O. (Kurnakow, Ch. Ztg. **14**. 113.)

$Co_2O_3, 3K_2O, 10MoO_3+10H_2O$. Sol. in H_2O. (Kurnakow.)

Cobaltous molybdate ammonia, $CoMoO_4, 2NH_3+H_2O$.

Sol. in H_2O. (Sonnenschein, J. pr. **53**. 340.)

Cupric molybdate, basic, $4CuO, 3MoO_3+5H_2O$.

Insol. in H_2O. (Struve, J. B. **1854**. 350.)

Cupric molybdate, $CuMoO_4$.

Sl. sol. in H_2O; decomp. by acids and alkaline solutions.

Cupric *tri*molybdate, $CuMo_3O_{10}+6\frac{1}{2}H_2O$.

Easily sol. in cold H_2O. (Ullik, A. **144**. 233.)

$+9H_2O$. Very sl. sol. in cold, and extraordinarily easily sol. in hot H_2O. (Ullik.)

Didymium molybdate, $Di_2(MoO_4)_3$.

Ppt. Insol. in H_2O. (Cossa, B. **19**. 536R.)

$Di_2O_3, 6MoO_3+3H_2O$ (?). Precipitate. (Smith.)

Glucinum molybdate, basic, $2GlO, MoO_3+3H_2O$.

Nearly insol. in H_2O. (Atterberg, J. B. **1873**. 258.)

Glucinum *di*molybdate, $GlMoO_4, MoO_3+xH_2O$.

Easily sol. in H_2O. (Atterberg.)

Gold (Auric) molybdate (?).

Sl. sol. in H_2O. Sol. in HCl, and HNO_3+Aq. (Richter.)

Iron (Ferrous) molybdate, $FeMoO_4$.

Insol. in H_2O. (Schultze, A. **126**. 55.)

Ferric molybdate, $Fe_2O_3, 4MoO_3+7H_2O$.

Nearly insol. in H_2O. Slowly sol. in cold, easily in hot HCl, or HNO_3+Aq. Dil. acids gradually dissolve out Fe_2O_3 in the cold. When ignited, difficultly sol. in all solvents. (Steinacker.)

Fe_2O_3, $5MoO_3+16H_2O$. Very sl. sol. in H_2O. (Struve, J. B. **1854.** 346.)

Ferric potassium molybdate, Fe_2O_3, $3K_2O$, $12MoO_3+20H_2O=3K_2Mo_2O_7$, $Fe_2(Mo_2O_7)_3+20H_2O$.

Sol. in H_2O. (Struve.)

Lanthanum molybdate, $LaH_3(MoO_4)_3=La_2O_3$, MoO_3+3H_2O (?).

Precipitate. (Smith.)

Lead molybdate, $PbMoO_4$.

Insol. in H_2O. Sol. in warm HNO_3+Aq; decomp. by H_2SO_4; sol. in conc. HCl+Aq, or KOH+Aq.

Min. *Wulfenite.* As above.

Lithium molybdate, $Li_2MoO_4+\frac{2}{3}H_2O$.

Easily sol. in H_2O.

Magnesium molybdate, $MgMoO_4+5H_2O$.

Easily sol. in cold, but still more sol. in hot H_2O. (Delafontaine.)

Sol. in 12-15 pts. cold H_2O. (Brandes.)

$+7H_2O$. Easily sol. in hot or cold H_2O. (Ullik.)

Magnesium *tri*molybdate, $MgMo_3O_{10}+10H_2O$.

Difficultly sol. in cold, very easily in hot H_2O. (Ullik.)

Magnesium *hepta*molybdate, $Mg_3Mo_7O_{24}+20H_2O$.

Quite sol. in cold, more easily in hot H_2O. (Ullik.)

Magnesium hydrogen *tetra*molybdate, $MgH_2(Mo_4O_{13})_2+19H_2O$.

Easily sol. in cold H_2O. (Ullik, A. **144.** 335.)

Magnesium hydrogen *octo*molybdate, $MgH_2(Mo_8O_{25})_2+29H_2O$.

Very difficultly sol. in cold, very easily sol. in hot H_2O. (Ullik, W. A. B. **60, 2.** 314.)

Magnesium potassium molybdate, $MgMoO_4$, $K_2MoO_4+2H_2O$.

Slowly sol. in cold, easily in hot H_2O. (Ullik, A. **144.** 343.)

Manganous molybdate, $MnMoO_4+H_2O$.

Insol. in H_2O. Sl. sol. in pure, easily sol. in acidified H_2O. Decomp. by alkalies or alkali carbonates+Aq. (Coloriano, Bull. Soc. (2) **50.** 451.)

Manganic potassium molybdate, $Mn_2(Mo_2O_7)_3$, $5K_2MoO_4+12H_2O$.

Sol. in 384 pts. H_2O at 17°, and more readily in boiling H_2O. (Struve, J. pr. **61.** 460.)

Mercurous molybdate, $Hg_2Mo_2O_7$.

Decomp. by H_2O. (Struve, J. B. **1854.** 350.)

Sol. in 500-600 pts. H_2O; decomp. by HNO_3+Aq. (Hatchett.)

Molybdenum molybdate.

See **Molybdenum oxides,** Mo_3O_7, Mo_4O_9, etc.

Nickel molybdate.

Sl. sol. in H_2O.

Nickel molybdate ammonia, $NiMoO_4$, $2NH_3+H_2O$.

Decomp. by H_2O. (Sonnenschein, J. pr. **53.** 341.)

Potassium molybdate, K_2MoO_4.

Deliquescent in moist air. Very sol. in H_2O. Insol. in alcohol. (Svanberg and Struve, J. pr. **44.** 265.)

Potassium *tri*molybdate, $K_2Mo_3O_{10}+3H_2O$.

Difficultly sol. in cold, but much more easily in hot H_2O. When ignited is absolutely insol. in H_2O. (Svanberg and Struve.)

Potassium *tetra*molybdate, $K_2Mo_4O_{13}$.

Precipitate.

Potassium *penta*molybdate, $K_2Mo_5O_{16}$.

Precipitate. (Svanberg and Struve.)

Potassium *hepta*molybdate, $K_6Mo_7O_{24}+4H_2O$.

Decomp. even by cold H_2O. (Delafontaine.)

Formula is $K_8Mo_9O_{31}+6H_2O$, according to Svanberg and Struve (?).

Potassium hydrogen *tetra*molybdate, $KHMo_4O_{13}+6H_2O$.

Decomp. by H_2O. (Ullik.)

Potassium sodium molybdate, K_2MoO_4, $2Na_2MoO_4+14H_2O$.

Very easily sol. in cold, still more easily in hot H_2O. (Delafontaine.)

Potassium zinc molybdate.

Sol. in H_2O. (Berzelius.)

Potassium molybdate hydrogen *di*oxide, $6K_2O$, $16MoO_3$, $4H_2O_2+13H_2O$.

Sol. in H_2O. (Bärwald, C. C. **1885.** 424.)

Rubidium molybdate, $Rb_6Mo_7O_{24}+4H_2O$.

Very sl. sol. in cold, much more easily sol. in hot H_2O. (Delafontaine, N. Arch. Sc. phys. nat. **30.** 233.)

Samarium molybdate, $Sm_2(MoO_4)_3$.

Insol. in H_2O. (Cleve.)

Samarium sodium molybdate, $Na_2Sm_2(MoO_4)_4$.

Insol. in H_2O. Easily sol. in warm dil. HNO_3+Aq. (Cleve.)

Silver (Argentous) molybdate, Ag_4O, $2MoO_3$.

Sol. in HNO_3+Aq. KOH+Aq dissolves MoO_3 and Ag_4O separates out. Not decomp. by dil. NH_4OH+Aq. (Wöhler and Rautenberg, A. **114.** 119.)

Does not exist. (Muthmann, B. **20.** 983.)

Silver molybdate, Ag_2MoO_4.

Somewhat sol. in H_2O; less when HNO_3 is present. (Richter.)

Very sl. sol. in pure H_2O; easily sol. in H_2O acidulated with HNO_3. (Struve and Svanberg.)

Sol. in KCN or $NaOH+Aq$. (Smith and Bradbury.)

$2Ag_2O$, $5MoO_3$. Somewhat sol. in H_2O. (Svanberg and Struve, J. B. **1847-48.** 412.)

Silver molybdate ammonia, Ag_2MoO_4, $4NH_3$.

Sol. in H_2O with rapid decomposition. (Widmann, Bull. Soc. (2) **20.** 64.)

Silver molybdate hydrogen *di*oxide, $13Ag_2O$, $2H_2O_2$, $32MoO_3$.

Ppt. (Bärwald, B. **17.** 1206.)

Sodium molybdate, Na_2MoO_4.

Anhydrous. Easily and completely sol. in H_2O.

$+2H_2O$. Sol. in H_2O.

$+10H_2O$. Efflorescent.

Sodium *di*molybdate, $Na_2Mo_2O_7$.

After ignition, very difficultly sol. in cold, and very slowly sol. in hot H_2O. (Svanberg and Struve.)

$+H_2O$. Easily sol. in H_2O.

Sodium *tri*molybdate, $Na_2Mo_3O_{10}$.

$+4H_2O$. Easily and completely sol. in cold H_2O. (Ullik.)

$+7H_2O$. Difficultly sol. in cold H_2O, but more easily than the corresponding K salt. 100 pts. H_2O dissolve 3·878 pts. at 20° and 13·7 pts. at 100°. (Ullik, A. **144.** 244.)

Sodium *tetra*molybdate, $Na_2Mo_4O_{13}+6H_2O$.

Difficultly sol. in cold, easily in hot H_2O. (Ullik.)

Sodium *hepta*molybdate, $Na_6Mo_7O_{24}+22H_2O$.

Efflorescent. Easily sol. in H_2O. (Ullik, A. **144.** 219.)

Sodium *octo*molybdate, $Na_2Mo_8O_{25}+4H_2O$.

Insol. in H_2O. (Ullik, W. A. B. **60, 2.** 312.)

Sodium *deka*molybdate, $Na_2Mo_{10}O_{31}+12H_2O$.

Difficultly sol. in H_2O.

$+21H_2O$. Abundantly but slowly sol. in cold H_2O. $=NaHMo_5O_{16}+10H_2O$. (Ullik.)

Sodium hydrogen *tetra*molybdate, $NaHMo_4O_{13}+8H_2O$.

Very sol. in hot or cold H_2O. (Ullik, A. **144.** 333.)

Sodium hydrogen *octo*molybdate, $NaHMo_8O_{25}+4H_2O$.

Insol. in H_2O. (Ullik.)

Strontium molybdate, $SrMoO_4$.

Sl. sol. in H_2O. (Schultze.)

Sol. in 9600 pts. H_2O at 17°. (Smith and Bradbury, B. **24.** 2930.)

Thallous molybdate, Tl_2MoO_4.

Insol. in H_2O. Sol. in alkalies. Insol. in alcohol. (Oettinger, J. B. **1864.** 254.)

Sl. sol. in hot or cold H_2O. (Ullik, J. B. **1867.** 234.)

$8Tl_2O$, $11MoO_3$. Sol. in hot H_2O. (Flemming, J. B. **1868.** 250.)

$3Tl_2O$, $8MoO_3$. (Flemming.)

Stannic molybdate.

Insol. in H_2O. Sol. in dil. or conc. HCl, or in $KOH+Aq$. Not decomp. by HNO_3+Aq. (Berzelius.)

Uranous molybdate.

Precipitate. Sol. in $HCl+Aq$. Decomp. by $KOH+Aq$.

Uranyl molybdate, $2UO_3$, $3MoO_3$ (?).

Insol. in H_2O. Sol. in strong acids and $(NH_4)_2CO_3+Aq$. (Berzelius.)

Yttrium molybdate.

Insol. in H_2O. Sol. in HNO_3+Aq. (Berlin.)

Zinc molybdate, $ZnMoO_4$.

Difficultly sol. in H_2O; easily in acids. (Schultze, A. **126.** 49.)

$+H_2O$. Sl. sol. in H_2O. Easily sol. in dil. acids. (Coloriano, Bull. Soc. (2) **50.** 451.)

Zinc *tri*molybdate, $ZnMo_3O_{10}+10H_2O$.

Very difficultly sol. in cold, but extraordinarily easily sol. in hot H_2O. (Ullik, W. A. B. **55, 2.** 767.)

Zinc *tetra*molybdate, $ZnMo_4O_{13}+8H_2O$.

Easily sol. in cold H_2O. (Ullik.)

Zinc molybdate ammonia, $ZnMoO_4$, $2NH_3+H_2O$.

(Sonnenschein, J. pr. **53.** 339.)

Molybdic sulphuric acid, MoO_3, SO_3.

Deliquescent. (Schultz-Sellack, B. **4.** 14.)

MoO_3, $3SO_3+2H_2O$ (?).

Molybdoiodic acid, HIO_3, $H_2MoO_4+H_2O$.

Easily sol. in H_2O. (Blomstrand, J. pr. (2) **40.** 320.)

Ammonium molybdoiodate, NH_4IO_3, H_2MoO_4.

Somewhat more sol. than K salt. (Blomstrand.)

Potassium molybdoiodate, $KHO_2IO_2MoO_2OH$, or KIO_3, MoO_3+2H_2O.

Ppt. Sl. sol. in H_2O. (Blomstrand, J. pr. (2) **40.** 320.)

Molybdoperiodic acid.

Ammonium molybdoperiodate, $5(NH_4)_2O$, I_2O_7, $12MoO_3+12H_2O$.

Sol. in H_2O. (Blomstrand, Sv. V. A. H. Bih. **1892.** No. 6.)

$4(NH_4)_2O$, I_2O_7, $8MoO_3+7H_2O$. Very sl. sol. in cold H_2O. (Blomstrand.)

Ammonium sodium ——, $2(NH_4)_2O$, Na_2O, I_2O_7, $2MoO_3+10H_2O$.

Very sl. sol. in H_2O. (B.)

Barium sodium ——, $9BaO$, Na_2O, $2I_2O_7$, $24MoO_3+28H_2O$.

Very sl. sol. in H_2O. (B.)

Calcium ——, $5CaO$, I_2O_7, $12MoO_3+26H_2O$.

Extremely sol. in H_2O. (Blomstrand.)

$4CaO$, I_2O_7, $12MoO_3+21H_2O$. Less sol. in H_2O than above salt.

Lithium ——, $5Li_2O$, I_2O_7, $12MoO_3+30H_2O$.

Not so efflorescent as Na salt. Sol. in H_2O. (B.)

$+18H_2O$. (B.)

Manganous sodium molybdoperiodate, $2MnO, 3Na_2O, I_2O_7, 12MoO_3+32H_2O$.

Sol. in H_2O. (B.)

Potassium ——, $5K_2O, I_2O_7, 12MoO_3+12H_2O$.

Not efflorescent. (Blomstrand.)

Sodium ——, $5Na_2O, I_2O_7, 12MoO_3+34H_2O$.

Efflorescent. Very sol. in H_2O. (Blomstrand, Sv. V. A. H. Bih. **1892**. No. 6. 24.)

$+26H_2O$. Not efflorescent. Very sol. in H_2O. (Blomstrand.)

Sodium strontium ——, $Na_2O, 4SrO, I_2O_7, 12MoO_3+20H_2O$.

Sol. in H_2O. (B.)

Molybdoselenious acid.

Ammonium molybdoselenite, $4(NH_4)_2O, 3SeO_2, 10MoO_3+4H_2O$.

More sol. in hot than cold H_2O; insol. in alcohol. (Péchard, A. ch. (6) **30**. 403.)

Ammonium potassium molybdoselenite, $2(NH_4)_2O, 2K_2O, 3SeO_2, 10MoO_3+5H_2O$.

Very sol. in H_2O; insol. in alcohol. (Péchard.)

Barium molybdoselenite, $4BaO, 3SeO_2, 10MoO_3+3H_2O$.

Sl. sol. in cold, easily in warm H_2O. (Péchard.)

Potassium molybdoselenite, $4K_2O, 3SeO_2, 10MoO_3+5H_2O$.

Very sol. in H_2O; insol. in alcohol. (Péchard.)

Sodium molybdoselenite, $4Na_2O, 3SeO_2, 10MoO_3+15H_2O$.

Very efflorescent, and sol. in H_2O; insol. in alcohol. (Péchard.)

Molybdosulphurous acid.

Ammonium molybdosulphite, $4(NH_4)_2O, 3SO_2, 10MoO_3+6H_2O$.

Sl. sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Péchard, A. ch. (6) **30**. 396.)

Ammonium potassium molybdosulphite, $2(NH_4)_2O, 2K_2O, 3SO_2, 10MoO_3+9H_2O$.

Sl. sol. in cold H_2O. Decomp. on warming. (Péchard.)

Potassium molybdosulphite, $4K_2O, 3SO_2, 10MoO_3+10H_2O$.

Very sl. sol. in H_2O, but decomp. on warming. (Péchard.)

Sodium molybdosulphite, $4Na_2O, 3SO_2, 10MoO_3+12H_2O$.

Very sol. in cold H_2O; insol. in alcohol. (Péchard.)

$+16H_2O$. Very efflorescent. (Péchard.)

Molybdous acid.

Magnesium molybdite, $Mg_2Mo_3O_8=2MgO, 3MoO_2$.

Not attacked by KOH, and HCl + Aq. (Muthmann, A. **238**. 108.)

Zinc molybdite, $Zn_2Mo_3O_8=2ZnO, 3MoO_2$.

Easily sol. in aqua regia. (Muthmann, A. **238**. 108.)

Molybdovanadates.

See **Vanadiomolybdates.**

Neodidymium.

See under **Didymium.**

Neodidymium oxide, Nd_2O_3.

Easily sol. in acids. (v. Welsbach, M. **6**. 477.)

Nickel, Ni.

Not attacked by H_2O. Very slowly sol. in dilute H_3PO_4, H_2SO_4, or HCl + Aq. (Tupputi, A. ch. **78**. 133.)

Very easily attacked by HNO_3 + Aq, and difficultly by hot H_2SO_4. When pure, is converted into passive condition by conc. HNO_3. (Nicklès, C. R. **38**. 284.)

Very sl. attacked by cold acids, except HNO_3 + Aq. (Tissier, C. R. **50**. 106.)

Not attacked by NaOH + Aq. (Venator, Dingl. **261**. 133.)

Nickel antimonide, NiSb.

Insol. in HCl + Aq; easily sol. in HNO_3 + Aq. (Christofle, **1863**.)

Min. *Breithauptite.* Insol. in acids; easily sol. in aqua regia.

Ni_3Sb_2. (Christofle.)

Nickel antimonide sulphide, $NiSb_2, NiS_2=NiSbS$.

Min. *Nickel glance, Ullmannite.*

Decomp. by HNO_3 + Aq; completely sol. in aqua regia with separation of S.

Nickel arsenide, NiAs.

Min. *Niccolite.* Sol. in conc. HNO_3 + Aq with separation of As_2O_3; more easily sol. in aqua regia.

$NiAs_2$. Min. *Chloanthite, Rammelsbergite.* Sol. in HNO_3 + Aq.

Nickel arsenide sulphide, $NiAs_2, NiS_2$.

Min. *Gersdorffite.* Partly sol. in HNO_3 + Aq with separation of S and As_2O_3; not attacked by KOH + Aq.

Nickel bromide, $NiBr_2$.

Deliquescent. Slowly sol. in H_2O.

$+3H_2O$. Deliquescent. Very sol. in H_2O, HCl + Aq, NH_4OH + Aq, alcohol, and ether. (Berthemot, A. ch. **44**. 389.)

Nickel stannic bromide.

See **Bromostannate, nickel.**

Nickel bromide ammonia, $NiBr_2, 6NH_3$.

Sol. in little H_2O, but decomp. by more. (Rammelsberg, Pogg. **55**. 243.)

Nickel carbonyl, $Ni(CO)_4$.

Insol. in H_2O; not attacked by dil. acids or alkalies or conc. HCl + Aq. Easily sol. in conc. HNO_3 + Aq and in aqua regia. Sol. in alcohol, benzene, and chloroform. (Mond, Langer, and Quincke, Chem. Soc. **57**. 749.)

Nickel chloride, $NiCl_2$.

Anhydrous. Not immediately sol. in H_2O, but gradually dissolves on boiling or by addition of HCl+Aq. Deliquesces on air, and is then easily sol. in H_2O. Sol. in NH_4OH+Aq. Sol. in alcohol. Sol. in hot HCl+Aq only slowly.

Sp. gr. of $NiCl_2$+Aq containing:

5	10	15	20	25 % $NiCl_2$.
1·0493	1·0995	1·1578	1·2245	1·3000

(B. Franz, J. pr. (2) **5.** 285.)

Sp. gr. of $NiCl_2$+Aq containing, in 1000 grms. H_2O, g. $NiCl_2+7H_2O$ at 23·1°:

128 g. (=½ mol.)	256	384	512	640	768	896	1024
1·057	1·107	1·149	1·187	1·220	1·249	1·276	1·301

Containing g. $NiCl_2$ (anhydrous):

65 g. (=½ mol.)	130	195	260	325	390
1·061	1·119	1·176	1·230	1·284	1·335

(Gerlach, Z. anal. **28.** 468.)

Anhydrous $NiCl_2$ is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

$+H_2O$. (Baubigny.)

$+2H_2O$. (Sabatier, Bull. Soc. (3) **1.** 88.)

$+6H_2O$. Deliquescent in moist, efflorescent in dry air; sol. in H_2O with evolution of heat. Sol. in 1·5 to 2 pts. H_2O. Easily sol. in alcohol. (Tupputi.)

$+7H_2O$. (Gerlach, *l.c.*)

Nickel rubidium chloride, $NiCl_2$, $2RbCl$.

Easily sol. in H_2O and HCl+Aq. (Godeffroy, B. **8.** 9.)

Nickel stannous chloride, $NiCl_2$, $SnCl_2+6H_2O$.

Sol. in H_2O. (Jörgensen.)

Nickel stannic chloride.

See **Chlorostannate, nickel.**

Nickel chloride ammonia, $NiCl_2$, $2NH_3$.

Sol. in H_2O, decomp. on boiling; insol. in alcohol.

$NiCl_2$, $6NH_3$. Sol. in cold H_2O without decomp. Insol. in alcohol. Very sl. sol. in conc. NH_4OH+Aq.

Nickel fluoride, NiF_2.

Sol. in about 5000 pts. H_2O; insol. in alcohol and ether. Not attacked by HCl, HNO_3, or H_2SO_4 even when hot. (Poulenc, C. R. **114.** 1426.)

$+2H_2O$. Decomp. by pure H_2O. Sol. in H_2O acidulated with HF. (Berzelius.)

$+3H_2O$. (Clarke, Sill. Am. J. (3) **13.** 291.)

Nickel potassium fluoride, NiF_2, KF.

$+H_2O$. Sol. in H_2O. (Wagner, B. **19.** 896.)

NiF_2, $2KF$. Sl. sol. in H_2O. Scarcely sol. in methyl or ethyl alcohol or benzene. (Poulenc, C. R. **114.** 747.)

Nickel potassium zirconium fluoride.

See **Fluozirconate, nickel potassium.**

Nickel manganic fluoride.

See **Fluomanganate, nickel.**

Nickel sodium fluoride, NiF_2, $NaF+H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Nickel stannic fluoride.

See **Fluostannate, nickel.**

Nickel titanium fluoride.

See **Fluotitanate, nickel.**

Nickel tungstyl fluoride.

See **Fluoxytungstate, nickel.**

Nickel vanadium fluoride.

See **Fluovanadate, nickel.**

Nickel zirconium fluoride.

See **Fluozirconate, nickel.**

Nickelous hydroxide, $4NiO_2H_2$, H_2O.

Very sl. sol. in H_2O. Sol. in acids. Insol. in KOH or $NaOH$+Aq. Somewhat difficultly sol. in $(NH_4)_2CO_3$ or NH_4OH+Aq, but easily sol. in presence of NH_4 salts. Sol in NH_4 salts+Aq. Sol. in KCN+Aq. (Rodgers, **1834.**)

Sol. in boiling NH_4Cl+Aq.

Insol. in methyl or amyl amine. (Wurtz.)

Not pptd. in presence of Na citrate. (Spiller.)

Not pptd. in presence of a large number of non-volatile organic substances, particularly $H_2C_4H_4O_6$. (Rose.)

Nickelic hydroxide, Ni_2O_3, $2H_2O$ (?).

(Wernicke, Pogg. **141.** 122.)

Ni_2O_3, $3H_2O$ (?). Sol. in acids as nickelous salt. Not attacked by boiling KOH or $NaOH$+Aq. Slowly sol. in $HC_2H_3O_2$+Aq. Sol. in NH_4OH, and NH_4 salts+Aq. (Odling.)

Nickel iodide, NiI_2.

Deliquescent and sol. in H_2O. (Erdmann, J. pr. **7.** 254.)

$+6H_2O$. Deliquescent. Easily sol. in H_2O. (Erdmann.)

Nickel iodide ammonia, NiI_2, $4NH_3$.

(Rammelsberg, Pogg. **48.** 119.)

NiI_2, $6NH_3$. Decomp. by H_2O. Sol. in warm dil. NH_4OH+Aq. Very sl. sol. in conc. NH_4OH+Aq. (Erdmann.)

Nickelous oxide, NiO.

Insol. in H_2O. Sol. in conc. acids, except when crystalline, when it is scarcely attacked by acids. (Ebelmen, C. R. **33.** 256.)

Very sl. sol. in boiling NH_4Cl+Aq. (Demarçay.)

Very slowly sol. in NH_4OH+Aq. Insol. in KOH, and $NaOH$+Aq.

Sol. in min. acids, especially HCl+Aq, when warmed; insol. in $HC_2H_3O_2$, NH_4Cl, and NH_4SCN+Aq. Insol. in conc. $NaOH$+Aq. (Zimmerman, A. **232.** 324.)

1 l. solution containing 418·6 g. sugar and 34·3 g. CaO dissolves 0·29 g. NiO. (Bodenbender, J. B. **1865.** 600.)

Min. *Bunsenite.*

Nickelic oxide, Ni_2O_3.

Sol. in HNO_3, H_2SO_4, or HCl+Aq with decomp., also in NH_4OH and $(NH_4)_2CO_3$+Aq. (Winkelblech, A. **13.** 259.)

Nickelonickelic oxide, $6NiO, Ni_2O_3+H_2O$.

(Schönbein, J. pr. **93.** 35.)

Ni_3O_4. Sol. in acids. (Baubigny, C. R. **87.** 1082.)

Nickel *per*oxide, Ni_3O_5 (?).

(Bayley, C. N. **39.** 81.)

Correct composition is Ni_2O_3. (Carnot, C. R. **108.** 610.)

Ni_4O_7 (?). (Wicke, Zeit. Ch. **1865.** 303.)

Nickel oxychloride.

Sl. sol. in H_2O. (Berzelius.)

$NiCl_2, 8NiO+13H_2O$. (Raoult, C. R. **69.** 826.)

Nickel oxyiodide, $NiI_2, 9NiO+15H_2O$.

Insol. in H_2O. Sol. in HNO_3+Aq or acetic acid. Insol. in NH_4OH+Aq. Alcohol dissolves out NiI_2. (Erdmann.)

Nickel phosphide, Ni_2P.

Sol. in HNO_3+Aq and aqua regia; insol. in HCl+Aq. (Struve, J. pr. **79.** 321.)

Ni_3P_2. (Rose, Pogg. **24.** 332.)

Ni_3P_2. (Gm. K. 6th ed. **3.** 542.)

Nickel selenide, NiSe.

Insol. in H_2O, dil. or conc. HCl+Aq; slowly sol. in HNO_3+Aq; easily in aqua regia. (Little, A. **112.** 211.)

Nickel *semi*sulphide, Ni_2S.

Sol. in HNO_3+Aq, with residue of S. Difficultly sol. in conc. HCl+Aq; insol. in dil. HCl+Aq. (Arfvedson, Pogg. **1.** 65; Gautier, C. R. **108.** 1111.)

Nickel *mono*sulphide, NiS.

Anhydrous. Insol. in H_2O, HCl, or H_2SO_4+Aq. Sol. in HNO_3+Aq or aqua regia.

Min. *Millerite.*

$+xH_2O$. Insol. in H_2O, but decomp. by H_2O in contact with the air (Clermont and Guiot, C. R. **84.** 714), or by boiling with H_2O. (Geitner, A. **139.** 354.)

Very sl. sol. in dil. HCl+Aq, and still less in $HC_2H_3O_2$+Aq. (Fresenius.)

More sol. in HNO_3+Aq, and easily in aqua regia.

Somewhat sol. in NH_4OH+Aq or solutions of alkali sulphides. Insol. in NH_4SH+Aq. (Fresenius.)

Sol. while yet moist in H_2SO_3+Aq. (Berthier.)

When recently pptd. sol. in KCN+Aq. (Haidlen.)

Pptd. in presence of non-volatile organic substances as tartaric acid, etc. (Rose.)

Sol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

Exists in a colloidal form in a very dil. solution. (Winnsinger, Bull. Soc. (2) **49.** 452.)

Nickel sulphide, Ni_3S_4.

Ni_4S_5. Min. *Polydymite.* Insol. in HCl+Aq. Sol. in HNO_3+Aq with separation of S.

Ni_5S_7. Min. *Beyrichite.* Sol. in HCl+Aq.

Nickel *di*sulphide, NiS_2.

(Fellenberg, Pogg. **50.** 75.)

Nickel potassium sulphide, $3NiS, K_2S$.

Insol. in H_2O. (Schneider, J. pr. (2) **9.** 209.)

Nickel telluride, Ni_2Te_3.

Min. *Melonite.* Sol. in HNO_3+Aq.

NiTe. (Fabre, C. R. **105.** 277.)

Niobium, Nb.

For niobium and its compounds, see columbium, Cb, and the corresponding compounds.

Nitratochloroplatinamine comps.

See **Chloronitratoplatinamine comps.**

Nitratocobalt octamine comps.

See **Nitratooctamine cobaltic comps.**

Nitratooctamine cobaltic carbonate, $(NO_3)_2Co_2(NH_3)_8(CO_3)_2+H_2O$.

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. **22.** 2650.)

—— **chloride,** $(NO_3)_2Co_2(NH_3)_8Cl_4+4H_2O$.

(Vortmann and Blasberg, B. **22.** 2652.)

—— **iodide,** $(NO_3)_2Co_2(NH_3)_8I_4+2H_2O$.

(Vortmann and Blasberg.)

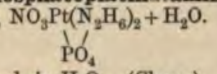
—— **nitrate.**

See **Octamine cobaltic nitrate.**

—— **sulphate,** $(NO_3)_2Co_2(NH_3)_8(SO_4)_2+2H_2O$.

$+4H_2O$. (Vortmann and Blasberg, B. **22.** 2652.)

Nitratophosphatoplatin*di*amine phosphate,



$$NO_3Pt(N_2H_6)_2 + H_2O \quad (\text{with } PO_4 \text{ bonded below})$$

Very sl. sol. in H_2O. (Cleve.)

Nitratoplatinamine nitrate, $(NO_3)_2Pt(NH_3NO_3)_2$.

Sl. sol. in cold, more easily in hot H_2O; easily sol. in dil. HNO_3+Aq. (Cleve.)

—— **nitrite,** $(NO_3)_2Pt(NH_3NO_2)_2$.

Easily sol. in H_2O. (Cleve.)

Nitratoplatin*di*amine chloride, $(NO_3)_2Pt(N_2H_6Cl)_2+H_2O$.

Moderately sol. in cold, very easily in hot H_2O.

—— **chloroplatinate,** $(NO_3)_2Pt(N_2H_6Cl)_2, PtCl_4+2H_2O$.

Ppt.

—— **chromate,** $(NO_3)_2Pt(N_2H_6)_2CrO_4$.

Nearly insol. in H_2O. (Cleve.)

—— ***di*chromate,** $(NO_3)_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in H_2O.

—— **nitrate,** $(NO_3)_2Pt(N_2H_6NO_3)_2$.

Sol. in H_2O. Insol. in HNO_3+Aq.

Nitrato*di*platin*di*amine nitrate, $(NO_3)_2Pt_2(N_2H_6)_4(NO_3)_4$.

Sol. in H_2O with decomp.

Nitratopurpureocobaltic bromide, $Co(NO_3)(NH_3)_5Br_2$.

Resembles the chloride in its properties. (Jörgensen, J. pr. (2) **23.** 227.)

—— **carbonate,** $Co(NO_3)(NH_3)_5(CO_3)+H_2O$.

Less sol. in H_2O than other purpureocarbonates. (Vortmann and Blasberg, B. **22.** 2648.)

—— **chloride,** $Co(NO_3)(NH_3)_5Cl_2$.

Sl. sol. in cold H_2O, but more than nitrate; more easily sol. in hot H_2O, but is converted into roseo salt. Insol. in $HCl+Aq$ or alcohol. (Jörgensen, J. pr. (2) **23.** 227.)

—— **mercuric chloride,** $Co(NO_3)(NH_3)_5Cl_2$, $HgCl_2$.

Not wholly insol. in H_2O. (Jörgensen.)

—— **chloroplatinate,** $Co(NO_3)(NH_3)_5Cl_2, PtCl_4$.

Ppt. Nearly insol. in cold H_2O. (Jörgensen.)

—— **chromate,** $Co(NO_3)(NH_3)_5CrO_4$.

Nearly insol. in H_2O. (Jörgensen.)

—— ***di*chromate.**

Sl. sol. in H_2O, but more easily than the neutral salt. (Jörgensen.)

—— **dithionate,** $Co(NO_3)(NH_3)_5S_2O_6$.

Very sl. sol. in cold, more easily in hot H_2O. (Jörgensen.)

—— **nitrate,** $Co(NO_3)(NH_3)_5(NO_3)_2$.

Sol. in 273 pts. H_2O at 16°. Much more sol. in hot H_2O containing HNO_3. (Jörgensen, J. pr. (2) **23.** 227.)

—— **cobaltic nitrite,** $3Co(NO_3)(NH_3)_5$, $2Co(NO_2)_6+2H_2O$.

Very sl. sol. in H_2O. (Jörgensen, Z. anorg. **5.** 176.)

—— **diamine cobaltic nitrite,** $Co(NO_3)(NH_3)_5$, $(NO_2)_4Co(NH_3)_2$.

Ppt. (Jörgensen.)

—— **oxalate,** $Co(NO_3)(NH_3)_5C_2O_4$.

Ppt.

—— **sulphate,** $Co(NO_3)(NH_3)_5SO_4+H_2O$.

Rather difficultly sol. in cold H_2O. (Jörgensen.)

Nitratopurpureorhodium chloride, $(NO_3)Rh(NH_3)_5Cl_2$.

Sl. sol. in cold H_2O, but more easily than the nitrate. (Jörgensen, J. pr. (2) **34.** 394.)

—— **dithionate,** $(NO_3)Rh(NH_3)_5S_2O_6+H_2O$.

Nearly insol. in cold H_2O. (Jörgensen.)

—— **nitrate,** $(NO_3)Rh(NH_3)_5(NO_3)_2$.

Very sl. sol. in cold H_2O. Insol. in alcohol. (Jörgensen.)

Nitric acid, HNO_3.

Miscible with H_2O. When HNO_3+Aq is distilled at 760 mm. pressure, an acid containing 68 % HNO_3 is formed, which boils at 120·5° under 735 mm. pressure. By distilling at 150 mm. pressure the acid contains 67·6 % HNO_3; at 70 mm. (b.-pt. 65-70°) the acid contains 66·7 % HNO_3. The percentage of HNO_3 in the liquid obtained by passing dry air into HNO_3+Aq containing 64-68 % HNO_3 varies with the temp.; the higher the temp. the greater the percentage of HNO_3. (Roscoe, Chem. Soc. **13.** 150.)

HNO_3+Aq of 1·51 sp. gr. contains 67 % N_2O_5.
" 1·42 " " 54
" 1·35 " " 44·4
" 1·315 " " 38·6
(Dalton.)

HNO_3+Aq of 1·54 sp. gr. contains 88·82 % N_2O_5.
" 1·522 " " 86·17 "
" 1·4 " " 44 "
(Mitscherlich.)

HNO_3+Aq of 1·298 sp. gr. contains 36·75 % N_2O_5. (Kirwan.)

HNO_3+Aq of 1·298 sp. gr contains 48 %. (Davy.)

HNO_3+Aq of 1·298 sp. gr. contains 32-33 %. (Berthollet.)

For Ure's table of sp. gr. of HNO_3+Aq, see Watt's Dict., 1st ed.

Sp. gr. of HNO_3+Aq at 0° and 15°.

% HNO_3	% N_2O_5	Sp. gr. at 0°	Sp. gr. at 15°
100·00	85·71	1·559	1·530
99·84	85·57	1·559	1·530
99·72	85·47	1·558	1·530
99·52	85·30	1·557	1·529
97·89	83·90	1·551	1·523
97·00	83·14	1·548	1·520
96·00	82·28	1·544	1·516
95·27	81·66	1·542	1·514
94·00	80·57	1·537	1·509
93·01	79·72	1·533	1·506
92·00	78·85	1·529	1·503
91·00	78·00	1·526	1·499
90·00	77·15	1·522	1·495
89·56	76·77	1·521	1·494
88·00	75·43	1·514	1·488
87·45	74·95	1·513	1·486
86·17	73·86	1·507	1·482
85·00	72·86	1·503	1·478
84·00	72·00	1·499	1·474
83·00	71·14	1·495	1·470
82·00	70·28	1·492	1·467
80·96	69·39	1·488	1·463
80·00	68·57	1·484	1·460
79·00	67·71	1·481	1·456
77·66	66·56	1·476	1·451
76·00	65·14	1·469	1·445
75·00	64·28	1·465	1·442
74·01	63·44	1·462	1·438
73·00	62·57	1·457	1·435
72·39	62·05	1·455	1·432
71·24	61·06	1·450	1·429
69·96	60·00	1·444	1·423
69·20	59·31	1·441	1·419
68·00	58·29	1·435	1·414
67·00	57·43	1·430	1·410
66·00	56·57	1·425	1·405
65·07	55·77	1·420	1·400
64·00	54·84	1·415	1·395
63·59	54·50	1·413	1·393
62·00	53·14	1·404	1·386

Sp. gr. of HNO_3, etc.—*Continued.*

% HNO_3	% N_2O_5	Sp. gr. at 0°	Sp. gr. at 15°
61·21	52·46	1·400	1·381
60·00	51·43	1·393	1·374
59·59	51·08	1·391	1·372
58·88	50·47	1·387	1·368
58·00	49·71	1·382	1·363
57·00	48·86	1·376	1·358
56·10	48·08	1·371	1·353
55·00	47·14	1·365	1·346
54·00	46·29	1·359	1·341
53·81	46·12	1·358	1·339
53·00	45·40	1·353	1·335
52·33	44·85	1·349	1·331
50·99	43·70	1·341	1·323
49·97	42·83	1·334	1·317
49·00	42·00	1·328	1·312
48·00	41·14	1·321	1·307
47·18	40·44	1·315	1·398
46·64	39·97	1·312	1·295
45·00	38·57	1·300	1·284
43·53	37·31	1·291	1·274
42·00	36·00	1·280	1·264
41·00	35·14	1·274	1·257
40·00	34·28	1·267	1·251
39·00	33·43	1·260	1·244
37·95	32·53	1·253	1·237
36·00	30·86	1·240	1·225
35·00	29·99	1·234	1·218
33·86	29·02	1·226	1·211
32·00	27·43	1·214	1·198
31·00	26·57	1·207	1·192
30·00	25·71	1·200	1·185
29·00	24·85	1·194	1·179
28·00	24·00	1·187	1·172
27·00	23·14	1·180	1·166
25·71	22·04	1·171	1·157
23·00	19·71	1·153	1·138
20·00	17·14	1·132	1·120
17·47	14·97	1·115	1·105
15·00	12·85	1·099	1·089
13·00	11·14	1·085	1·077
11·41	9·77	1·075	1·067
7·72	6·62	1·050	1·045
4·00	3·42	1·026	1·022
2·00	1·71	1·013	1·010
0·00	0·00	1·000	0·999

(Kolb, A. ch. (4) **10.** 140.)

Sp. gr. of HNO_3+Aq at 15°. a = %; b = sp. gr. if % is N_2O_5; c = sp. gr. if % is HNO_3.

a	b	c	a	b	c
1	1·007	1·006	11	1·076	1·064
2	1·014	1·012	12	1·083	1·070
3	1·021	1·018	13	1·091	1·077
4	1·027	1·024	14	1·098	1·083
5	1·034	1·029	15	1·104	1·089
6	1·040	1·035	16	1·112	1·095
7	1·047	1·040	17	1·120	1·100
8	1·053	1·045	18	1·126	1·106
9	1·061	1·051	19	1·134	1·112
10	1·069	1·057	20	1·141	1·120

Sp. gr. of HNO_3+Aq at 15°, etc.—*Continued.*

a	b	c	a	b	c
21	1·149	1·126	61	1·427	1·380
22	1·156	1·132	62	1·432	1·386
23	1·165	1·138	63	1·436	1·390
24	1·172	1·145	64	1·440	1·395
25	1·180	1·151	65	1·445	1·400
26	1·187	1·159	66	1·449	1·405
27	1·195	1·166	67	1·452	1·410
28	1·202	1·172	68	1·457	1·414
29	1·211	1·179	69	1·461	1·419
30	1·218	1·185	70	1·466	1·422
31	1·225	1·192	71	1·470	1·427
32	1·232	1·198	72	1·474	1·430
33	1·240	1·204	73	1·478	1·435
34	1·248	1·210	74	1·482	1·439
35	1·255	1·218	75	1·486	1·442
36	1·264	1·225	76	1·490	1·445
37	1·271	1·230	77	1·494	1·449
38	1·280	1·236	78	1·499	1·452
39	1·286	1·244	79	1·503	1·456
40	1·295	1·251	80	1·507	1·460
41	1·304	1·257	81	1·511	1·463
42	1·312	1·264	82	1·515	1·467
43	1·318	1·270	83	1·519	1·470
44	1·325	1·276	84	1·523	1·474
45	1·332	1·284	85	1·527	1·478
46	1·340	1·290	86	1·530	1·481
47	1·346	1·298	87	...	1·484
48	1·352	1·304	88	...	1·488
49	1·360	1·312	89	...	1·491
50	1·366	1·316	90	...	1·495
51	1·372	1·323	91	...	1·499
52	1·378	1·329	92	...	1·503
53	1·385	1·335	93	...	1·506
54	1·390	1·341	94	...	1·509
55	1·396	1·346	95	...	1·512
56	1·401	1·356	96	...	1·516
57	1·407	1·358	97	...	1·520
58	1·413	1·363	98	...	1·523
59	1·418	1·369	99	...	1·526
60	1·423	1·374	100	...	1·530

(Kolb, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. HNO_3+Aq at 17·5°.

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
10	1·068	40	1·293	70	1·465
15	1·104	50	1·361	80	1·500
20	1·140	60	1·417	85	1·514
30	1·217	...	...	...	...

(Hager, Adjumenta varia, Leipzig, **1876.**)

Sp. gr. of HNO_3+Aq at 17·5°.

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
5	1·032	9	1·060	13	1·089
6	1·038	10	1·068	14	1·096
7	1·045	11	1·075	15	1·104
8	1·053	12	1·082	16	1·111

Sp. gr. of HNO_3, etc.—*Continued.*

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
17	1·118	40	1·294	63	1·434
18	1·125	41	1·301	64	1·438
19	1·132	42	1·308	65	1·442
20	1·140	43	1·315	66	1·447
21	1·147	44	1·323	67	1·451
22	1·155	45	1·330	68	1·456
23	1·163	46	1·338	69	1·460
24	1·170	47	1·345	70	1·465
25	1·178	48	1·352	71	1·469
26	1·186	49	1·358	72	1·472
27	1·194	50	1·364	73	1·476
28	1·201	51	1·371	74	1·480
29	1·209	52	1·377	75	1·484
30	1·217	53	1·383	76	1·488
31	1·224	54	1·389	77	1·492
32	1·232	55	1·394	78	1·496
33	1·239	56	1·400	79	1·500
34	1·247	57	1·406	80	1·504
35	1·255	58	1·412	81	1·508
36	1·263	59	1·416	82	1·512
37	1·271	60	1·421	83	1·516
38	1·279	61	1·426	84	1·519
39	1·287	62	1·430	85	1·523

(Hager, Comm. **1883**.)

Sp. gr. of HNO_3 + Aq at 15°.

% HNO_3	Sp. gr.	% HNO_3	Sp. gr.
1	1·00581	26	1·15869
2	1·01136	27	1·16660
3	1·01713	28	1·17371
4	1·02286	29	1·18073
5	1·02851	30	1·18830
6	1·03439	31	1·19552
7	1·04019	32	1·20276
8	1·04592	33	1·20635
9	1·05234	34	1·21300
10	1·05746	35	1·22013
11	1·06330	36	1·22675
12	1·06951	37	1·23347
13	1·07581	38	1·23980
14	1·08126	39	1·24510
15	1·08843	40	1·25235
16	1·09500	41	1·25850
17	1·10102	42	1·26475
18	1·10725	43	1·27125
19	1·11321	44	1·27785
20	1·12024	45	1·28450
21	1·12714	46	1·29110
22	1·13349	47	1·29780
23	1·13890	48	1·30443
24	1·14460	49	1·31101
25	1·15164	50	1·31722

(Squires, Pharm. Era, Jan. **1891**.)

Most accurate table.

Sp. gr. of HNO_3 + Aq at 15°; H_2O at 4° = 1.

Sp. gr.	% N_2O_5	% HNO_3	Kg. HNO_3 in 1 l.
1·000	0·08	0·10	0·001
1·005	0·85	1·00	0·010
1·010	1·62	1·90	0·019
1·015	2·39	2·80	0·028
1·020	3·17	3·70	0·038
1·025	3·94	4·60	0·047
1·030	4·71	5·50	0·057
1·035	5·47	6·38	0·066
1·040	6·22	7·26	0·075
1·045	6·97	8·13	0·085
1·050	7·71	8·99	0·094
1·055	8·43	9·84	0·104
1·060	9·15	10·68	0·113
1·065	9·87	11·51	0·123
1·070	10·57	12·33	0·132
1·075	11·27	13·15	0·141
1·080	11·96	13·95	0·151
1·085	12·64	14·74	0·160
1·090	13·31	15·53	0·169
1·095	13·99	16·32	0·179
1·100	14·67	17·11	0·188
1·105	15·34	17·89	0·198
1·110	16·00	18·67	0·207
1·115	16·67	19·45	0·217
1·120	17·34	20·23	0·227
1·125	18·00	21·00	0·236
1·130	18·66	21·77	0·246
1·135	19·32	22·54	0·256
1·140	19·98	23·31	0·266
1·145	20·64	24·08	0·276
1·150	21·29	24·84	0·286
1·155	21·94	25·60	0·296
1·160	22·60	26·36	0·306
1·165	23·25	27·12	0·316
1·170	23·90	27·88	0·326
1·175	24·54	28·63	0·336
1·180	25·18	29·38	0·347
1·185	25·83	30·13	0·357
1·190	26·47	30·88	0·367
1·195	27·10	31·62	0·378
1·200	27·74	32·36	0·388
1·205	28·36	33·09	0·399
1·210	28·99	33·82	0·409
1·215	29·61	34·55	0·420
1·220	30·24	35·28	0·430
1·225	30·88	36·03	0·441
1·230	31·53	36·78	0·452
1·235	32·17	37·53	0·463
1·240	32·82	38·29	0·475
1·245	33·47	39·05	0·486
1·250	34·13	39·82	0·498
1·255	34·78	40·58	0·509
1·260	35·44	41·34	0·521
1·265	36·09	42·10	0·533
1·270	36·75	42·87	0·544
1·275	37·41	43·64	0·556
1·280	38·07	44·41	0·568
1·285	38·73	45·18	0·581
1·290	39·39	45·95	0·593
1·295	40·05	46·72	0·605

Sp. gr. of HNO_3, etc.—*Continued.*

Sp. gr.	% N_2O_5	% HNO_3	Kg. HNO_3 in 1 l.
1·300	40·71	47·49	0·617
1·305	41·37	48·26	0·630
1·310	42·06	49·07	0·643
1·315	42·76	49·89	0·656
1·320	43·47	50·71	0·669
1·325	44·17	51·53	0·683
1·330	44·89	52·37	0·697
1·335	45·62	53·22	0·710
1·340	46·35	54·07	0·725
1·345	47·08	54·93	0·739
1·350	47·82	55·79	0·753
1·355	48·57	56·66	0·768
1·360	49·35	57·57	0·783
1·365	50·13	58·48	0·798
1·370	50·91	59·39	0·814
1·375	51·69	60·30	0·829
1·380	52·52	61·27	0·846
1·385	53·35	62·24	0·862
1·390	54·20	63·23	0·879
1·395	55·07	64·25	0·896
1·400	55·97	65·30	0·914
1·405	56·92	66·40	0·933
1·410	57·86	67·50	0·952
1·415	58·83	68·63	0·971
1·420	59·83	69·80	0·991
1·425	60·84	70·98	1·011
1·430	61·86	72·17	1·032
1·435	62·91	73·39	1·053
1·440	64·01	74·68	1·075
1·445	65·13	75·98	1·098
1·450	66·24	77·28	1·121
1·455	67·38	78·60	1·144
1·460	68·56	79·98	1·168
1·465	69·79	81·42	1·193
1·470	71·06	82·90	1·219
1·475	72·39	84·45	1·246
1·480	73·76	86·05	1·274
1·485	75·18	87·70	1·302
1·490	76·80	89·60	1·335
1·495	78·57	91·60	1·369
1·500	80·65	94·09	1·411
1·501	81·09	94·60	1·420
1·502	81·50	95·08	1·428
1·503	81·91	95·55	1·436
1·504	82·29	96·00	1·444
1·505	82·63	96·39	1·451
1·506	82·94	96·76	1·457
1·507	83·26	97·13	1·464
1·508	83·58	97·50	1·470
1·509	83·87	97·84	1·476
1·510	84·09	98·10	1·481
1·511	84·28	98·32	1·486
1·512	84·46	98·53	1·490
1·513	84·63	98·73	1·494
1·514	84·78	98·90	1·497
1·515	84·92	99·07	1·501
1·516	85·04	99·21	1·504
1·517	85·15	99·34	1·507
1·518	85·26	99·46	1·510
1·519	85·35	99·57	1·512
1·520	85·44	99·67	1·515

(Lunge and Rey, Z. f. angew. Ch. **1891.** 165.)

Dinitric acid, $H_2N_4O_{11} = 2N_2O_5, H_2O$.

Fumes on air. Miscible with H_2O, with evolution of much heat. (Weber, J. pr. (2) **6.** 342.)

Nitrates.

All nitrates are sol. in H_2O except a few basic compounds. Most nitrates are insol. in conc. HNO_3+Aq; many are sol. in alcohol; some are sol. in glycerine.

Aluminum nitrate, basic, $2Al_2O_3, 3N_2O_5 + 3H_2O$.

Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 203.)

Basic aluminum nitrates containing 2 mols. or less of Al_2O_3 to one of N_2O_5 may be obtained sol. in H_2O, but the compounds containing more than 2 mols. Al_2O_3 are insol. in H_2O. (Ordway, *l.c.*)

$2Al_2O_3, N_2O_5 + 10H_2O$. (Ditte, C. R. **110.** 782.)

Aluminum nitrate, $Al(NO_3)_3 + 9H_2O$.

Deliquescent. Very sol. in H_2O, HNO_3+Aq, or alcohol. (Berzelius.)

Melts in its crystal H_2O at 72·7°. (Ordway.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

Ammonium nitrate, NH_4NO_3.

Deliquescent.

Sol. in 0·502 pt. H_2O at 18°. (Karsten.)

Sol. in 0·54 pt. H_2O at 10°. (Harris, C. R. **24.** 816.)

Much more sol. in hot than cold H_2O. (Harris.)

Sol. in 2 pts. H_2O at 15·5° and 0·5 pt. boiling H_2O. (Fourcroy.)

Sol. in 1 pt. cold, and 0·5 pt. boiling H_2O. (Fourcroy.)

Sol. in 0·5 pt. H_2O at 18°. (Berzelius.)

Sol. in 2 pts. H_2O at 18°. (Abl.)

Decomp. by boiling H_2O.

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4NO_3	t°	Pts. NH_4NO_3	t°	Pts. NH_4NO_3
0	97	24	205	48	351
1	101	25	210	49	358
2	105	26	216	50	365
3	109	27	221	51	372
4	113	28	226	52	379
5	117	29	232	53	387
6	121	30	238	54	395
7	125	31	244	55	402
8	130	32	250	56	410
9	134	33	256	57	418
10	139	34	262	58	425
11	143	35	268	59	433
12	148	36	274	60	441
13	152	37	280	61	449
14	157	38	286	62	457
15	161	39	292	63	465
16	166	40	298	64	473
17	170	41	304	65	481
18	175	42	311	66	490
19	180	43	317	67	499
20	185	44	324	68	508
21	190	45	331	69	517
22	195	46	337	70	526
23	200	47	344	...	...

(Mulder, Scheik. Verhandel. **1864.** 95.)

100 pts. H_2O dissolve 183 pts. NH_4NO_3 at 19·5°. (Mulder.)

60 pts. NH_4NO_3 mixed with 100 pts. H_2O lower the temperature from 13·6° to −13·6°, that is 27·2°, but if the initial temperature is 0° it will fall only to −16·7°, the freezing-point of the mixture. (Rüdorff, B. **2**. 68.)

Sp. gr. of NH_4NO_3+Aq at 18°.

Pts. NH_4NO_3	Pts. H_2O	Sp. gr.
80	1800	1·0180
80	900	1·0331
80	360	1·0743

(Thomsen and Gerlach, Z. anal. **28**. 520.)

Sp. gr. of NH_4NO_3+Aq at 15°.

% NH_4NO_3	Sp. gr.	% NH_4NO_3	Sp. gr.
5	1·0201	30	1·1304
10	1·0419	40	1·1780
20	1·0860	50	1·2279

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of NH_4NO_3+Aq at 17·5°.

% NH_4NO_3	Sp. gr.	% NH_4NO_3	Sp. gr.
1	1·0042	33	1·1454
2	1·0085	34	1·1502
3	1·0127	35	1·1550
4	1·0170	36	1·1598
5	1·0212	37	1·1646
6	1·0255	38	1·1694
7	1·0297	39	1·1742
8	1·0340	40	1·1790
9	1·0382	41	1·1841
10	1·0425	42	1·1892
11	1·0468	43	1·1942
12	1·0512	44	1·1994
13	1·0555	45	1·2045
14	1·0599	46	1·2096
15	1·0642	47	1·2147
16	1·0686	48	1·2198
17	1·0729	49	1·2249
18	1·0773	50	1·2300
19	1·0816	51	1·2353
20	1·0860	52	1·2407
21	1·0905	53	1·2460
22	1·0950	54	1·2514
23	1·0995	55	1·2567
24	1·1040	56	1·2621
25	1·1085	57	1·2674
26	1·1130	58	1·2728
27	1·1175	59	1·2781
28	1·1220	60	1·2835
29	1·1265	61	1·2888
30	1·1310	62	1·2942
31	1·1358	63	1·3005
32	1·1406	64	1·3059

(Gerlach, Z. anal. **27**. 310.)

There is no limit to b.-pt. of NH_4NO_3+Aq. (Gerlach, Z. anal. **26**. 427.)

B.-pt. of NH_4NO_3 + Aq containing pts. NH_4NO_3 to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26**. 445); L=according to Legrand (A. ch. (2) **59**. 426.)

B.-pt.	G	L	B.-pt.	G	L
101°	10	10	140°	682	770·5
102	20	20·5	141	719	...
103	30	31·3	142	737	840·6
104	41	42·4	143	765	...
105	52	53·8	144	793	915·5
106	63	65·4	145	823	...
107	74	77·3	146	853	995·5
108	85	89·4	147	883	...
109	96	101·9	148	914	1081·5
110	108	114·9	149	945	...
111	120	128·4	150	977	1173·5
112	132	142·4	151	1009	...
113	145	156·9	152	1043	1273
114	158	172	153	1079	...
115	172	188	154	1116	1383
116	187	204·4	155	1155	...
117	202	221·4	156	1196	1504
118	217	238·4	157	1238	...
119	232	256·8	158	1281	1637
120	248	275·3	159	1325	...
121	265	...	160	1370	1775
122	283	314	161	1417	...
123	301	...	162	1464	1923
124	319	354	163	1511	...
125	337	...	164	1558	2084
126	356	396	165	1606	...
127	376	...	166	1653	...
128	396	440·2	167	1700	...
129	417	...	168	1748	...
130	439	487·4	169	1796	...
131	461	...	170	1844	...
132	484	537·3	180	2400	∞
133	507	...	190	3112	...
134	530	590	200	4099	...
135	554	...	210	5618	...
136	578	645	220	8547	...
137	603	...	230	16950	...
138	629	705·5	240	∞	...
139	655	...	...	...	...

Very sol. in HNO_3+Aq. (Schulz, Zeit. Ch. **1869**. 531.)

100 pts. H_2O dissolve 29·1 pts. NH_4Cl and 173·8 pts. NH_4NO_3. (Rüdorff, B. **6**. 484.)

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl until a state of equilibrium is reached. (Karsten.)

Addition of $KClO_3$ to NH_4Cl+Aq prevents pptn. of NH_4Cl, and dissolves any NH_4Cl that may have been pptd. (Margueritte, C. R. **38**. 306.)

See also under **Ammonium chloride.**

NH_4NO_3 + KNO_3.

100 pts. H_2O dissolve:

	At 9°		At 11°		At 15°	
	(1)	(2)	(3)	(4)	(5)	(6)
KNO_3 .	20·2	40·6	...	26·0	46·2	...
NH_4NO_3	...	88·8	143	...	130·4	161

2, Sat. at 11° with NH_4NO_3 and then at 9° with KNO_3; 5, sat. at 11° with NH_4NO_3 and then at 15° with KNO_3. (Mulder.)

Sol. in sat. KNO_3+Aq without causing ppt. (Karsten); with separation of KNO_3 (Rüdorff).

Composition of solution is dependent on the relative excess of the salts present. (Rüdorff.)

100 pts. H_2O dissolve 77·1 pts. $NaNO_3$ and 162·9 pts. NH_4NO_3 at 16°. (Rüdorff, B. **6.** 484.)

If a sat. solution of NH_4NO_3+Aq at 11° is sat. with $Ba(NO_3)_2$ at 9°, 100 pts. H_2O dissolve:

	At 11°		At 9°
NH_4NO_3 . .	143	101·3	...
$Ba(NO_3)_2$ . .	...	6·2	6·8

(Mulder.)

1 pt. NH_4NO_3 dissolves in 2·29 pts. alcohol of 66·8 % at 25°. (Pohl, W. A. B. **6.** 599.)

1 pt. NH_4NO_3 dissolves in 1·1 pt. boiling alcohol. (Wenzel.)

100 pts. absolute methyl alcohol dissolve 17·1 pts. at 20·5°.

100 pts. absolute ethyl alcohol dissolve 3·8 pts. at 20·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sp. gr. of alcoholic solution of NH_4NO_3 at 15°.

Pts. NH_4NO_3	Pts. alcohol	Sp. gr.
0	100	0·83904
2	98	0·84746
4	96	0·85604
6	94	0·86524

(Gerlach, Z. anal. **28.** 521.)

Ammonium hydrogen nitrate, $NH_4H(NO_3)_2$.

Sol. in H_2O. (Ditte, C. R. **89.** 576, 641.)

Ammonium *di*hydrogen nitrate, $NH_4H_2(NO_3)_3$.

Sol. in H_2O. (Ditte.)

Ammonium cerous nitrate, $3NH_4NO_3$, $2Ce(NO_3)_3+12H_2O$.

Very deliquescent. Very sol. in H_2O and alcohol. (Holzmann, J. pr. **84.** 78.)

$2NH_4NO_3$, $Ce(NO_3)_3+4H_2O$. As above. (Marignac, A. ch. (4) **30.** 64.)

Ammonium ceric nitrate, $2NH_4NO_3$, $Ce(NO_3)_4+1\frac{1}{2}H_2O$.

Very deliquescent. (Holzmann, J. pr. **84.** 78.)

Ammonium cobalt nitrate.

Permanent. Sol. in H_2O. (Thénard.)

Ammonium copper nitrate, $2NH_4NO_3$, $Cu(NO_3)_2$.

Very sol. in H_2O.

Ammonium didymium nitrate, $2NH_4NO_3$, $Di(NO_3)_3+4H_2O$.

Somewhat deliquescent.

Ammonium auric nitrate (**Ammonium auronitrate**), $NH_4Au(NO_3)_4$.

Extremely deliquescent.

$H(NH_4)_2Au(NO_3)_6$. (Schottländer, A. **217.** 312.)

Ammonium lanthanum nitrate, $2NH_4NO_3$, $La(NO_3)_3+4H_2O$.

Not deliquescent. Sol. in H_2O. (Marignac.)

Ammonium magnesium nitrate, $2NH_4NO_3$, $Mg(NO_3)_2$.

Slowly deliquescent. Sol. in 10 pts. H_2O at 12·5°, and much less hot H_2O. (Fourcroy.)

Ammonium mercurous nitrate, $4NH_4NO_3$, $Hg_2(NO_3)_2+5H_2O$.

Sol. in H_2O. (Pagenstecher, Repert. **14.** 188.)

Ammonium nickel nitrate.

Sol. in 3 pts. cold H_2O. (Thénard, Scher. J. **10.** 428.)

Ammonium silver nitrate, NH_4NO_3, $AgNO_3$.

Very sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26.** 357.)

Ammonium nitrate ammonia, $2NH_4NO_3$, $3NH_3$.

Known only as a solution of NH_3 in NH_4NO_3+Aq. (Troost, C. R. **94.** 789.)

NH_4NO_3, $3NH_3$. As above.

Ammonium nitrate mercuric chloride, NH_4NO_3, $2HgCl_2$.

Insol. in H_2O. Ether dissolves out $HgCl_2$. (Kosmann, A. ch. (3) **27.** 240.)

Ammonium nitrate *meta*tungstate, NH_4NO_3, $2(NH_4)_2W_4O_{13}+4H_2O$.

Decomposes by recrystallising out of H_2O. (Marignac, A. ch. (3) **69.** 61.)

Antimony nitrate, Sb_4O_6, N_2O_5.

Decomp. by cold H_2O. (Bucholz.)

Aqueous solution sat. at 10° contains 30·4 % salt. (Eller.)

Sol. in strong, less sol. in dil. HNO_3+Aq. (Peligot, A. ch. (3) **20.** 288.)

Barium nitrate, $Ba(NO_3)_2$.

Sol. in H_2O with absorption of heat.

100 pts. H_2O at 0° dissolve 5·0 parts $Ba(NO_3)_2$. (Gay-Lussac, A. ch. **11.** 313.)

100 pts. H_2O at 0° dissolve 5·2 parts $Ba(NO_3)_2$. (Mulder.)

$Ba(NO_3)_2+Aq$ sat. at 20° contains 8·57 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and has 1·0679 sp. gr. (Karsten); sat. at 20° has 1·064 sp. gr., and contains 7·94 pts. $Ba(NO_3)_2$ to 100 pts. H_2O. (Michel and Krafft.)

100 pts. H_2O dissolve pts. $Ba(NO_3)_2$ at t°.

t°	Pts. $Ba(NO_3)_2$	t°	Pts. $Ba(NO_3)_2$
0	5·00	52·11	17·97
14·95	8·18	73·75	25·01
17·62	8·54	86·21	29·57
37·87	13·67	101·65	35·18
49·22	17·07	...	...

(Gay-Lussac, A. ch. (2) **11.** 313.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Ba(NO_3)_2$	t°	Pts $Ba(NO_3)_2$
0	5·0	52	17·7
1	5·1	53	18·1
2	5·3	54	18·4
3	5·5	55	18·7
4	5·7	56	19·0
5	6·0	57	19·3
6	6·2	58	19·6
7	6·4	59	20·0
8	6·6	60	20·3
9	6·8	61	20·6
10	7·0	62	20·9
11	7·3	63	21·0
12	7·5	64	21·6
13	7·7	65	21·9
14	7·9	66	22·3
15	8·1	67	22·6
16	8·3	68	22·9
17	8·5	69	23·3
18	8·8	70	23·6
19	9·0	71	23·9
20	9·2	72	24·3
21	9·5	73	24·9
22	9·7	74	25·0
23	9·9	75	25·4
24	10·1	76	25·7
25	10·4	77	26·0
26	10·6	78	26·4
27	10·8	79	26·7
28	11·1	80	27·0
29	11·3	81	27·4
30	11·6	82	27·7
31	11·8	83	28·1
32	12·1	84	28·4
33	12·3	85	28·8
34	12·6	86	29·1
35	12·8	87	29·5
36	13·1	88	29·8
37	13·4	89	30·2
38	13·7	90	30·6
39	14·0	91	30·9
40	14·2	92	31·3
41	14·5	93	31·7
42	14·8	94	32·0
43	15·1	95	32·4
44	15·4	96	32·7
45	15·6	97	33·1
46	15·9	98	33·5
47	16·2	99	33·8
48	16·5	100	34·2
49	16·8	101	34·5
50	17·1	101-9	34·8
51	17·4	...	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. **1864.** 50.)

Sp. gr. of $Ba(NO_3)_2+Aq$ at 19·5°.

% $Ba(NO_3)_2$	Sp. gr.	% $Ba(NO_3)_2$	Sp. gr.
1	1·009	6	1·050
2	1·017	7	1·060
3	1·025	8	1·069
4	1·034	9	1·078
5	1·042	10	1·087

(Calculated by Gerlach, Z. anal. **8.** 286, from Kremers, Pogg. **95.** 110.)

Sp. gr. of $Ba(NO_3)_2+Aq$ at 18°.

% $Ba(NO_3)_2$	Sp. gr.
4·2	1·0340
8·4	1·0712

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $Ba(NO_3)_2+Aq$ at 17·5°.

% $Ba(NO_3)_2$	Sp. gr.	% $Ba(NO_3)_2$	Sp. gr.
1	1·0085	6	1·0510
2	1·0170	7	1·0600
3	1·0255	8	1·0690
4	1·0340	Sat. sol.	1·0690
5	1·0425	...	...

(Gerlach, Z. anal. **27.** 283.)

Saturated $BaNO_3+Aq$ contains:—

36·18 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101·1°. (Griffiths.)

35·2 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101·65°. (Gay-Lussac.)

34·8 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101·9°. (Mulder.)

34·8 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 102·5°. (Kremers.)

Sat. $Ba(NO_3)_2+Aq$ forms a crust at 101·1°; highest temp. observed was 101·5°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Ba(NO_3)_2+Aq$ containing pts. $Ba(NO_3)_2$ to 100 pts. H_2O.

B.-pt.	Pts. $Ba(NO_3)_2$
100·5°	12·5
101·0	26·0
101·1	27·5

(Gerlach, Z. anal. **26.** 440.)

Insol. in conc. HNO_3+Aq, and much less sol. in dil. HNO_3+Aq or $HCl+Aq$ than in H_2O.

Less sol. in dil. $HC_2H_3O_2+Aq$ than in dil. $HCl+Aq$.

Solubility in NH_4Cl+Aq is the same as in H_2O.

Less sol. in NH_4OH+Aq, $NH_4C_2H_3O_2+Aq$, or NH_4NO_3+Aq than in H_2O. (Pearson, Zeit. Ch. (2) **5.** 662.)

$Ba(NO_3)_2$ is sol. in about:

13·33 pts. H_2O at ord. temp., and 4·67 pts. at 100°.

14·67 pts. NH_4OH+Aq (conc.) at ord. temp., and 5·67 pts. at 100°.

16·50 pts. NH_4OH+Aq (1 vol. conc. +3 vols. H_2O) at ord. temp.

28·00 pts. $HCl+Aq$ (1 vol. conc. $HCl+4$ vols. H_2O) at ord. temp.

29·00 pts. $HC_2H_3O_2+Aq$ (1 vol. commercial $HC_2H_3O_2+1$ vol. H_2O) at ord. temp.

13·67 pts. NH_4Cl+Aq (1 pt. NH_4Cl+10 pts. H_2O) at ord. temp., and 4·67 pts. at 100°.

24·00 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3+10 pts. H_2O) at ord. temp.

17·33 pts. $NH_4C_2H_3O_2+Aq$ (dil. NH_4OH neutralised by dil. $HC_2H_3O_2$) at ord. temp., and 4·33 pts. at 100°.

14·67 pts. $Na_2CH_3O_2+Aq$ (dil. $HC_2H_3O_2$ neutralised by Na_2CO_3 and dil. with 4 vols. H_2O) at ord. temp., and 5·33 pts. at 100°.

17·33 pts. $Cu(C_2H_3O_2)_2+Aq$ (see Stolba, Z. anal. **2.** 390) at ord. temp., and 6·00 pts. at 100°.

18·67 pts. grape sugar (1 pt. grape sugar +10 pts. H_2O) at ord. temp. (Pearson, Zeit. Ch. **1869.** 662.)

Sol. in sat. NH_4Cl+Aq without pptn. at first, but finally NH_4Cl is pptd. until a certain state of equilibrium is reached. (Karsten.)

Very sl. sol. in sat. $Pb(NO_3)_2+Aq$. (Karsten.)

100 pts. sat. $Ba(NO_3)_2+Pb(NO_3)_2+Aq$ contain 33·95 pts. of the two salts at 19-20°. (v. Hauer, J. pr. **98.** 137.)

100 pts. sat. $Ba(NO_3)_2+Sr(NO_3)_2+Aq$ contain 45·96 pts. of the two salts at 19-20°. (v. Hauer, *l.c.*)

100 pts. sat. $Ba(NO_3)_2+Pb(NO_3)_2+Sr(NO_3)_2+Aq$ contain 45·90 pts. of the three salts at 19-20°. (v. Hauer, *l.c.*)

$Ba(NO_3)_2+KNO_3$.

100 pts. H_2O dissolve:

	(Mulder) (1)		
KNO_3	29·7	28·8	...
$Ba(NO_3)_2$	...	5·4	8·9
		34·2	

	(Karsten) (2)	(Karsten) (3)	(Kopp) (4)	(Kopp) (5)
KNO_3	13·31	29·03	5·7	3·5
$Ba(NO_3)_2$	6·91	1·00	33·1	36·3
	20·22	30·03	38·8	39·8

1. Sat. $Ba(NO_3)_2+Aq$ sat. with KNO_3 at 18·5°.
2. To sat. KNO_3+Aq, $Ba(NO_3)_2+Aq$ was added.
3. To sat. $Ba(NO_3)_2+Aq$, KNO_3 was added.
4. Both salts in excess $+Aq$ at 21·5°.
5. Both salts in excess $+Aq$ at 23°.

$Ba(NO_3)_2+NaNO_3$.

$Ba(NO_3)_2$ is sol. in sat. $NaNO_3+Aq$ without separation.

100 pts. H_2O dissolve:

	(Karsten) At 18·75°		
$NaNO_3$	86·6	88·14	...
$Ba(NO_3)_2$	...	3·77	8·9

	(Kopp) At 20·2°		
$NaNO_3$	87·7	88·6	...
$Ba(NO_3)_2$	...	3·6	9·2

Insol. in absolute alcohol.

Solubility in dilute alcohol increases with the temp. (Gerardin, A. ch. (4) **5.** 145.)

Completely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. **143.** 314.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Barium mercurous nitrate, $2BaO, 2Hg_2O, 3N_2O_5$.

Decomp. by H_2O. Sol. in hot dil. HNO_3+Aq and hot $Hg_2(NO_3)_2+Aq$, from which it crystallises on cooling. (Städeler, A. **87.** 129.)

Barium nitrate *meta***tungstate**, $2Ba(NO_3)_2, BaW_4O_{13}+6H_2O$.

Efflorescent. Sol. in warm H_2O. (Péchard, A. ch. (6) **22.** 198.)

Bismuth nitrate, basic, $Bi_2O_3, N_2O_5+2H_2O$.

Sol. in a large amount of H_2O. Sol. in HNO_3+Aq. (Heintz.)

Sol. in 135 pts. H_2O at 90-93°. (Ruge, J. B. **1862.** 163.)

$+\frac{1}{2}H_2O$. Sol. in much H_2O. (Yvon, C. R. **84.** 1161.)

$+H_2O$. (Ruge.)

$2Bi_2O_3, N_2O_5$. Not acted upon by H_2O. (Ditte, C. R. **84.** 1317.)

$+H_2O$. (Yvon.)

$Bi_2O_3, 2N_2O_5+H_2O$. (Ruge.)

$11Bi_2O_3, 5N_2O_5+16H_2O$. Not decomp. by H_2O. (Yvon.)

Bismuth nitrate, $Bi(NO_3)_3+10H_2O$.

Permanent. Decomp. by little H_2O with separation of a basic salt. This decomposition is prevented by slight excess of HNO_3, and then the salt is completely sol. in a large amount of H_2O. (Rose.)

Sol. in dil. HNO_3+Aq. Not decomp. by H_2O in presence of $HC_2H_3O_2$ or $\frac{1}{200}$ pt. NH_4NO_3. (Löwe, J. pr. **74.** 341.)

Melts in crystal H_2O with decomp. at 74°. (Ordway.)

Insol. in acetone. (Krug and M'Elroy.)

$+1\frac{1}{2}H_2O$. (Ditte.)

$+5\frac{1}{2}H_2O$. (Yvon, C. R. **84.** 1161.)

Cadmium nitrate, basic, $Cd(OH)NO_3+H_2O$.

Decomp. by H_2O, or ordinary alcohol. (Klinger, B. **16**. 997.)

$12CdO, N_2O_5+11H_2O$. Sl. sol. in H_2O; more sol. in H_2O than basic sulphate. (Habermann, **5**. 432.)

$5CdO, 2N_2O_5+8H_2O$. Decomp. by cold H_2O. (Rousseau and Tite, C. R. **114**. 1184.)

Cadmium nitrate, $Cd(NO_3)_2+4H_2O$.

Deliquescent, and very sol. in H_2O.

Sp. gr. of aqueous solution containing:

5	10	15	20	25 % $Cd(NO_3)_2$,
1·0528	1·0978	1·1516	1·2134	1·2842
30	35	40	45	50 % $Cd(NO_3)_2$.
1·3566	1·4372	1·5372	1·6474	1·7608

(Franz, J. pr. (2) **5**. 274.)

Sat. $Cd(NO_3)_2+Aq$ boils at 132°. Almost entirely insol. in conc. HNO_3+Aq. (Wurtz.)

M.-pt. of $Cd(NO_3)_2+4H_2O=59·5°$. (Ordway; Tilden, Chem. Soc. **45**. 409.)

Sol. in alcohol.

Cadmium nitrate ammonia, $Cd(NO_3)_2, 6NH_3+H_2O$.

(André, C. R. **104**. 987.)

Cæsium nitrate, $CsNO_3$.

100 pts. H_2O dissolve 10·58 pts. $CsNO_3$ at 3·2°. Sl. sol. in absolute alcohol. (Bunsen.)

Cæsium silver nitrate, $CsNO_3, AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26**. 357.)

Calcium nitrate, basic, $Ca(NO_3)_2, CaO_2H_2+2\frac{1}{2}H_2O$.

Decomp. by H_2O. (Werner, A. ch. (6) **27**. 570.)

$+H_2O$. As above. (Rousseau and Tite, C. R. **114**. 1184.)

Calcium nitrate, $Ca(NO_3)_2$.

Deliquescent. Very sol. in H_2O with evolution of much heat.

100 pts. H_2O at 0° dissolve 84·2 pts. $Ca(NO_3)_2$. (Poggiale.)

100 pts. H_2O at 0° dissolve 93·1 pts. $Ca(NO_3)_2$. (Mulder.)

$+4H_2O$.

Sol. in 0·25 pt. cold H_2O with reduction of temp. Sol. in all proportions in boiling H_2O. (Berzelius.)

Sol. in 2 pts. cold, and 0·6667 pt. boiling H_2O. (Fourcroy.)

Sat. $Ca(NO_3)_2+Aq$ at 12·5° contains 33·8 %. (Hassenfratz, A. ch. **28**. 29.)

Sp. gr. of $Ca(NO_3)_2+Aq$ at 17·5°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
1	1·009	35	1·328
5	1·045	40	1·385
10	1·086	45	1·447
15	1·129	50	1·515
20	1·174	55	1·588
25	1·222	60	1·666
30	1·272	...	...

(Franz, J. pr. (2) **5**. 274.)

Sp. gr. of $Ca(NO_3)_2+Aq$ at 17·5°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
10	1·076	40	1·368
20	1·163	50	1·483
30	1·261	60	1·605

(Gerlach, Z. anal. **27**. 283.)

Sp. gr. of $Ca(NO_3)_2+Aq$ at 18°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
6·25	1·0487	37·5	1·3546
12·5	1·1016	50·0	1·5102
25·0	1·2198	...	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $Ca(NO_3)_2+Aq$ at 24·65°. a = no. of g. × ½ mol. wt. dissolved in 1000 g. H_2O; b = sp. gr. if a is $Ca(NO_3)_2, 4H_2O$, ½ mol. wt. = 118; c = sp. gr. if a is $Ca(NO_3)_2$, ½ mol. wt. = 82.

a	b	c	a	b	c
1	1·056	1·059	6	1·243	1·286
2	1·104	1·112	7	1·270	1·323
3	1·145	1·160	8	1·294	...
4	1·181	1·205	9	1·316	...
5	1·213	1·246	10	1·336	...

(Favre and Valson, C.R. **79**. 968.)

Saturated $Ca(NO_3)_2+Aq$ containing 351·2 pts. $Ca(NO_3)_2$ to 100 pts. H_2O boils at 151°; (Legrand) 152° (Kremers.)

Forms a crust at 141°, and contains 333·5 pts. $Ca(NO_3)_2$ to 100 pts. H_2O; highest temp. observed, 151°. (Gerlach, Z. anal. **26**. 427.)

B.-pt. of $Ca(NO_3)_2+Aq$ containing pts. $Ca(NO_3)_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26**. 447); L = according to Legrand (A. ch. (2) **59**. 436).

B.-pt.	G	L	B.-pt.	G	L
101°	10	15	118°	157	136·1
102	20	25·3	119	163·5	142·1
103	30	34·4	120	170	148·1
104	40	42·6	121	176	...
105	50	50·4	122	182·5	160·1
106	60	57·8	123	189	...
107	70	64·9	124	195·5	172·2
108	80	71·8	125	202	...
109	89	78·6	126	208·5	184·5
110	98	85·3	127	215·5	...
111	106·5	91·9	128	222·5	197·0
112	114·5	98·4	129	230	...
113	122·5	104·8	130	237·5	209·5
114	130	111·2	131	245	...
115	137·5	117·5	132	253	222·2
116	144	123·8	133	261·5	...
117	150·5	130	134	270	235·1

B.-pt. of $Ca(NO_3)_2$, etc.—*Continued.*

B.-pt.	G	L	B.-pt.	G	L
135°	278·5	...	144°	364·5	302·6
136	287	248·1	145	375	...
137	296	...	146	386	317·4
138	305	261·3	147	397·5	...
139	314·5	...	148	409	333·2
140	324	274·7	149	420·5	...
141	333·5	...	150	432·5	351·2
142	343·5	288·4	151	444·5	362·2
143	354	...	151·97	455·68	...

Sat. $Ca(NO_3)_2$+Aq boils at 132°. (Ordway, Sill. Am. J. (2) **27.** 14.)

$Ca(NO_3)_2+4H_2O$ melts in its crystal H_2O at 44°. (Tilden, Chem. Soc. **45.** 409.)

Conc. HNO_3 precipitates $Ca(NO_3)_2$ from its aqueous solution. (Mitscherlich, Pogg. **18.** 159.)

Sol. in glacial $HC_2H_3O_2$. (Persoz.)

Sol. in sat. KNO_3+Aq with elevation of temp. and pptn. of a portion of KNO_3. (Fourcroy and Vauquelin, A. ch. **11.** 135.)

Sol. in 0·8 pt. alcohol (Macquer); 1 pt. boiling alcohol. (Bergmann.)

Dry $Ca(NO_3)_2$ is sol. in 7 pts. alcohol at 15° and 1 pt. boiling alcohol. (Bergmann.)

Sol. in 1·87 pts. ether-alcohol (1 : 1). (Fresenius, Z. anal. **32.** 191.)

Ether ppts. $Ca(NO_3)_2$ from its alcoholic solution. Easily sol. in boiling amyl alcohol. (Browning, Sill. Am. J. **143.** 53.)

Min. *Nitrocalcite.*

Cerous nitrate, $Ce(NO_3)_3+6H_2O$.

Not very deliquescent. (Jolin.)

Very sol. in H_2O; sol. in 2 pts. alcohol. (Vauquelin.)

Ceric nitrate, $Ce(NO_3)_4$.

Deliquescent. Decomp. by hot H_2O. (Berzelius.)

Sol. in alcohol. (Dumas.)

Basic compounds containing 12 mols. or less CeO_2 to 1 mol. N_2O_5 may be obtained, which are sol. in H_2O. (Ordway.)

Cerous cobaltous nitrate, $2Ce(NO_3)_3$, $3Co(NO_3)_2+24H_2O$.

Deliquescent. Easily forms supersaturated solutions. (Lange, J. pr. **82.** 129.)

Cerous magnesium nitrate, $2Ce(NO_3)_3$, $3Mg(NO_3)_2+24H_2O$.

Slightly deliquescent. Easily sol. in H_2O or alcohol, and easily forms supersaturated solutions. (Holzmann, J. pr. **75.** 330.)

Cerous manganous nitrate, $2Ce(NO_3)_3$, $3Mn(NO_3)_2+24H_2O$.

Sol. in H_2O. (Lange, J. pr. **82.** 129.)

Cerous nickel nitrate, $2Ce(NO_3)_3$, $3Ni(NO_3)_2+24H_2O$.

Easily sol. in H_2O. (Holzmann, J. pr. **75.** 321.)

Cerous potassium nitrate, $Ce(NO_3)_3$, $2KNO_3+2H_2O$.

Sol. in H_2O. (Lange, J. pr. **82.** 136.)

Ceric potassium nitrate, $Ce(NO_3)_4$, $2KNO_3+1\frac{1}{2}H_2O$.

Efflorescent. (Holzmann, J. pr. **75.** 324.)

Ceric sodium nitrate.

Deliquescent. Decomp. by recrystallisation. (Holzmann.)

Cerous zinc nitrate, $2Ce(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

Sol. in H_2O. Easily forms supersat. solutions. (Lange, J. pr. **82.** 129.)

Ceroceric zinc nitrate (?), Ce_3O_4, $2ZnO$, $6N_2O_5+18H_2O$ (?).

Easily sol. in H_2O. (Holzmann, J. pr. **75.** 321.)

Chromic nitrate, basic, $Cr_2O(NO_3)_4$.

Sol. in H_2O. (Löwel.)

$+12H_2O$. Sol. in H_2O. (Ordway.)

Chromic nitrate, $Cr(NO_3)_3+9H_2O$.

Very sol. in H_2O and alcohol. (Löwel.)

Melts in its crystal H_2O at 36·5°. Sat. $Cr(NO_3)_3$+Aq boils at 125·6°. (Ordway.)

Chromium nitrate chloride, $CrCl_2(NO_3)$.

Sol. in H_2O and alcohol. (Schiff, A. **124.** 177.)

$Cr(NO_3)_2Cl$. (Schiff.)

Chromium nitrate sulphate, $Cr_2(SO_4)(NO_3)_4$.

Hygroscopic. Completely sol. in H_2O.

$Cr_2(SO_4)_2(NO_3)_2$. Sol. in H_2O. (Schiff, A. **124.** 174.)

Cobaltous nitrate, basic, $6CoO$, $N_2O_5+5H_2O$.

Ppt. Gradually sol. in H_2O with deposition of CoO. (Winkelblech, A. **13.** 155.)

Sol. in cold HCl, and HNO_3+Aq. Decomp. by hot KOH+Aq.

$4CoO$, $N_2O_5+6H_2O$. Ppt. (Habermann, M. **5.** 432.)

Cobaltous nitrate, $Co(NO_3)_2+6H_2O$.

Deliquescent in moist air. Very sol. in H_2O.

Sp. gr. of aqueous solution at 17·5° containing:

5	10	15	20	% $Co(NO_3)_2$,
1·0462	1·0906	1·1378	1·1936	
25	30	35	40	% $Co(NO_3)_2$.
1·2538	1·3190	1·3896	1·4662	

Sp. gr. of sat. solution = 1·5382.

(Franz, J. pr. (2) **5.** 274.)

Melts in its crystal H_2O at 56° (Ordway); 38° (Tilden).

Easily sol. in alcohol. Sol. in 1 pt. strong alcohol at 12·5°. (Wenzel.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Cobaltous didymium nitrate, $3Co(NO_3)_2$, $2Di(NO_3)_3+48H_2O$.

Very deliquescent. (Frerichs and Smith, A. **191.** 331.)

Cobaltous nitrate ammonia, $Co(NO_3)_2, 6NH_3 + 2H_2O$.

Decomp. by H_2O with separation of basic nitrate. (Fremy.)
Sol. in $NH_4OH + Aq$. (Hess.)

Cupric nitrate, basic, $4CuO, N_2O_5 + 3H_2O$.

Insol. in H_2O. Easily sol. in acids. (Graham, A. **29.** 13.)
$+3\frac{1}{2}H_2O$. Insol. in H_2O and decomp. by heat. (Casselman, Z. anal. **4.** 24.)

Cupric nitrate, $Cu(NO_3)_2 + 3H_2O$.

Deliquescent. Very easily sol. in H_2O or alcohol; also in moderately conc. $HNO_3 + Aq$, but is precipitated from conc. aqueous solution by $HNO_3 + Aq$ of 1·522 sp. gr. (Mitscherlich, Pogg. **18.** 159.)
Melts in crystal H_2O at 114·5°. (Ordway; Tilden, Chem. Soc. **45.** 409.)
Sol. in 1 pt. strong alcohol at 12·5°. (Wenzel.)
$+6H_2O$. Efflorescent. Melts in crystal H_2O at 38°. (Ordway.)

Sp. gr. of $Cu(NO_3)_2 + Aq$ at 17·5° containing:

5	10	15	% anhydrous salt,
1·0452	1·0942	1·1442	
20	25	30	% anhydrous salt,
1·2036	1·2644	1·3298	
35	40	45	% anhydrous salt.
1·3974	1·4724	1·5576	

(B. Franz, J. pr. (2) **5.** 274.)

Sat. $Cu(NO_3)_2 + Aq$ boils at about 173°. (Griffiths.)

Cupric nitrate ammonia (**Cuprammonium nitrate**), $Cu(NO_3)_2, 4NH_3$.

Easily sol. in H_2O, from which it can be recrystallised. Sol. in alcohol. (Berzelius.)

Didymium nitrate, basic, $4Di_2O_3, 3N_2O_5 + 15H_2O$.

Insol. in H_2O. (Marignac.)
$2Di_2O_3, 3N_2O_5$. (Becquerel, A. ch. (6) **14.** 257.)

Didymium nitrate, $Di(NO_3)_3$.

Anhydrous. Very sol. in H_2O. As sol. in 96 % alcohol as in H_2O, and the solution is not precipitated by much ether. Insol. in pure ether. (Marignac, A. ch. (3) **36.** 161.)
$+6H_2O$. Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 361.)

Didymium nickel nitrate, $2Di(NO_3)_3, 3Ni(NO_3)_2 + 36H_2O$.

Very deliquescent. (Frerichs and Smith, A. **191.** 355.)

Didymium zinc nitrate, $2Di(NO_3)_3, 3Zn(NO_3)_2 + 69H_2O$.

Very deliquescent. (F. and S.)

Didymium nitrate oxalate, $Di_2H_2(NO_3)_2(C_2O_4)_3 + 11H_2O$.

Insol. in $HNO_3 + Aq$. (Cleve, Bull. Soc. (2) **43.** 259.)

Erbium nitrate, basic, $2Er_2O_3, 3N_2O_5 + 9H_2O$.

Decomp. by H_2O. Sl. sol. in HNO_3. (Bahr and Bunsen.)
$3Er_2O_3, 4N_2O_5 + 20H_2O$. (Cleve, Bull. Soc. (2) **21.** 344.)

Erbium nitrate, $Er(NO_3)_3 + 6H_2O$.

Easily sol. in H_2O, alcohol, and ether. (Höglund.)

Gallium nitrate, $Ga(NO_3)_3$.

Very deliquescent, and sol. in H_2O. (Dupré.)

Glucinum nitrate, basic, $2GlO, N_2O_5 + 3H_2O$ (?).

Sol. in H_2O.
$3GlO, N_2O_5$. Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 205.)
Compounds more basic than this are insol. in H_2O. (Ordway.)

Glucinum nitrate, $Gl(NO_3)_2 + 3H_2O$.

Very deliquescent. (Joy, Sill. Am. J. (2) **36.** 90.)
Easily sol. in H_2O and alcohol. (Vauquelin.)
Melts in its crystal H_2O at 29·4°. (Ordway.)
Sat. $Gl(NO_3)_2 + Aq$ boils at 140·5°. (Ordway.)

Gold (Auric) nitrate, basic, $Au_2O_3, N_2O_5 + \frac{2}{5}H_2O$, or **Auryl nitrate,** $(AuO)NO_3 + \frac{1}{5}H_2O$.

(Schottländer, A. **217.** 364.)
$2Au_2O_3, N_2O_5 + 2H_2O = Au_4O_5(NO_3)_2 + 2H_2O$. Slowly sol. in $HNO_3 + Aq$ at 100°. (Schottländer, A. **217.** 356.)

Auric hydrogen nitrate, $Au(NO_3)_3, HNO_3 + 3H_2O$.

Decomp. by H_2O. Sol. in $HNO_3 + Aq$. (Schottländer, A. **217.** 356.)

Auric potassium nitrate, $KAu(NO_3)_4$.

Easily sol. in H_2O.
$HK_2Au(NO_3)_6$. Decomp. immediately by H_2O.
$2KAu(NO_3)_4, K_2HAu(NO_3)_6$. (Schottländer, J. B. **1884.** 453.)

Auric rubidium nitrate, $RbAu(NO_3)_4$.

Easily sol. in H_2O.
$HRb_2Au(NO_3)_6$. As above. (Schottländer.)

Auric thallium nitrate, $TlAu(NO_3)_4$.

Easily sol. in H_2O.
$6Au_2O_3, 2Tl_2O_3, 3N_2O_5 + 15H_2O$. Ppt. (Schottländer.)

Indium nitrate, $In(NO_3)_3 + 4\frac{1}{2}H_2O$.

Very deliquescent. Easily sol. in H_2O and absolute alcohol. (Winkler.)
$+1\frac{1}{2}H_2O$.

Iron (Ferrous) nitrate, $Fe(NO_3)_2 + 6H_2O$.

100 pts. of crystals dissolve in 50 pts. H_2O at 0°, sp. gr. of solution = 1·44; 40·8 pts. H_2O at 15°, sp. gr. of solution = 1·48; 33·3 pts. H_2O at 25°, sp. gr. of solution = 1·50. (Ordway, Sill. Am. J. (2) **40.** 325.)
$Fe(NO_3)_2 + Aq$ decomposes on heating; less rapidly when dil., more readily in presence of excess of acid. (Ordway.)

Ferric nitrate, basic, $36Fe_2O_3$, $N_2O_5+48H_2O$ (?).

Easily sol. in H_2O. Sl. sol. in dil. HNO_3+Aq; very sl. sol. in alcohol. (Hausmann, A. **89.** 111.)

$8Fe_2O_3$, $N_2O_5+12H_2O$. Sl. sol. in H_2O; very sl. sol. in cold or warm dil. HNO_3+Aq; more easily sol. in hot HCl+Aq. (Hausmann.)

$+xH_2O$. Sol. in H_2O; completely pptd. from aqueous solution by NaCl, NH_4Cl, KI, $KClO_3$, Na_2SO_4, $CaSO_4$, $ZnSO_4$, $CuSO_4$, KNO_3, $NaNO_3$, $Ba(C_2H_3O_2)_2$, or $Zn(C_2H_3O_2)_2$+Aq. More slowly pptd. by NH_4NO_3, $Mg(NO_3)_2$, $Ba(NO_3)_2$, or $Pb(NO_3)_2$+Aq. Not pptd. by alcohol, $Pb(C_2H_3O_2)_2$, $Cu(C_2H_3O_2)_2$, $Hg(CN)_2$, $AgNO_3$, or As_2O_3+Aq. (Ordway, Sill. Am. J. (2) **9.** 30.)

$4Fe_2O_3$, $N_2O_5+1\frac{1}{2}H_2O$. Easily sol. in H_2O; sl. sol. in dil. HNO_3+Aq, and in alcohol. (Hausmann.)

$+3H_2O$. Insol. in H_2O or HNO_3+Aq; sol. in HCl+Aq. (Scheurer-Kestner, C. R. **87.** 927.)

$+9H_2O$. Not deliquescent; easily sol. in H_2O. (Ordway.)

$3Fe_2O_3$, $N_2O_5+2H_2O$. Insol. in H_2O. (Scheurer-Kestner.)

$2Fe_2O_3$, $N_2O_5+H_2O$. Decomp. by H_2O. (Scheurer-Kestner.)

$+8H_2O$. (S.-K.)

Fe_2O_3, N_2O_5. Decomp. by H_2O. (S.-K.)

Fe_2O_3, $2N_2O_5$. Sol. in H_2O or alcohol in all proportions. Insol. in HNO_3+Aq.

N_2O_5 with 1, 2, 3, 4, 5, 6, and $8Fe_2O_3$ forms compounds, sol. in H_2O. (Ordway.)

Ferric nitrate, $Fe(NO_3)_3$.

$+H_2O$. (Scheurer-Kestner, A. ch. (3) **65.** 113.)

$+6H_2O$. Deliquescent, and sol. in any amount of H_2O. (Schönbein, Pogg. **39.** 141.)

$+9H_2O$. Deliquescent. Sol. in H_2O and alcohol. Sl. sol. in HNO_3+Aq. 2 pts. salt with 1 pt. H_2O lower the temperature 18·5°. (Scheurer-Kestner.)

Sp. gr. of solution at 17·5° containing:

5	10	15	20	25 % $Fe(NO_3)_3$,
1·0398	1·0770	1·1182	1·1612	1·2110

30	35	40	45	50 % $Fe(NO_3)_3$,
1·2622	1·3164	1·3746	1·4338	1·4972

55	60	65 % $Fe(NO_3)_3$.
1·5722	1·6572	1·7532

(Franz, J. pr. (2) **5.** 274.)

Nearly insol. in conc. HNO_3+Aq at temp. below 15·5°.

Easily sol. in alcohol.

Melts. in crystal H_2O at 47·2°. (Ordway.)

Sat. $Fe(NO_3)_3$+Aq boils at 125°. (Ordway.)

Lanthanum nitrate, $La(NO_3)_3+6H_2O$.

Very deliquescent; easily sol. in H_2O and alcohol. (Mosander.) Melts in its crystal H_2O at 40°; boils at 124·5°. (Ordway.)

Lanthanum magnesium nitrate, $2La(NO_3)_3$, $3Mg(NO_3)_2+24H_2O$.

Deliquescent in moist air. (Holzmann, J. pr. **75.** 350.)

Lanthanum manganous nitrate, $2La(NO_3)_3$, $3Mn(NO_3)_2+24H_2O$.

Sol. in H_2O. (Damour and Deville.)

Lanthanum nickel nitrate, $2La(NO_3)_3$, $3Ni(NO_3)_2+36H_2O$.

Very sol. in H_2O. (Frerichs and Smith, A. **191.** 355.)

Lanthanum zinc nitrate, $2La(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

Very sol. in H_2O. (Damour and Deville, J. B. **1858.** 135.)

$+69H_2O$. (Frerichs and Smith, A. **191.** 355.)

Lead nitrate, basic, 2PbO, $N_2O_5+H_2O=Pb(OH)NO_3$.

Sol. in 5·15 pts. H_2O at 19·2°. (Pohl, W. A. B. **6.** 597.) Very sl. sol. in cold, much more in hot H_2O. (Berzelius.) Sol. in $Pb(C_2H_3O_2)_2$+Aq. (Guignet, C. R. **56.** 358.)

$+2H_2O$. (André, C. R. **100.** 639.)

3PbO, $N_2O_5+1\frac{1}{2}H_2O$. Sl. sol. in pure H_2O. Insol. in H_2O containing HCl. (Berzelius.)

$+3H_2O$. Sol. in 119·2 pts. cold, and 10·5 pts. boiling H_2O. Sol. in $Pb(C_2H_3O_2)_2$+Aq, but sl. sol. in KNO_3+Aq. (Vogel, jr. A. **94.** 97.)

=10PbO, $3N_2O_5+5H_2O$. (Wakemann and Wells, Am. Ch. J. **9.** 299.)

$+4H_2O$. (André, C. R. **100.** 639.)

6PbO, $N_2O_5+H_2O$. Nearly insol. in H_2O. (Löwe, J. pr. **98.** 385.)

10PbO, $3N_2O_5+4H_2O$. Less sol. in H_2O than $Pb(NO_3)OH$, and not decomp. by boiling H_2O. (Wakemann and Wells, Am. Ch. J. **9.** 299.)

Lead nitrate, $Pb(NO_3)_2$.

Sol. in H_2O with absorption of much heat. (Rose.)

1 pt. $Pb(NO_3)_2$ dissolves in 7½ pts. cold H_2O. (Mitscherlich.)

1 pt. $Pb(NO_3)_2$ dissolves in 1·989 pts. H_2O at 17·5° and forms a liquid of 1·3978 sp. gr. (Karsten.)

1 pt. $Pb(NO_3)_2$ dissolves in 1·707 pts. H_2O at 22·3°; in 1·585 pts. H_2O at 24·7°. (Kopp.)

Sol. in 1·87 pts. H_2O at 17·5°. (Schiff, A. **109.** 326.)

100 pts. $Pb(NO_3)_2$+Aq sat. at 102·2° contain 52·5 pts. $Pb(NO_3)_2$, or 100 pts. H_2O dissolve 110·526 pts. $Pb(NO_3)_2$ at 102·2°. (Griffiths.)

Sol. in 7·5 pts. cold H_2O and much less hot H_2O. (Wittstein.)

100 pts. boiling H_2O dissolve 13 pts. $Pb(NO_3)_2$. (Ure's Dict.)

100 pts. $Pb(NO_3)_2$+Aq sat. at 19-20° contain 35·80 pts. salt. (v. Hauer, W. A. B. **53,** **2.** 221.)

1 pt. dissolves:

at	0°	10°	25°	45°	65°	85°	100°	
in	2·58	2·07	1·65	1·25	0·99	0·83	0·72	pts. H_2O.

(Kremers, Pogg. **92.** 497.)

1 l. $Pb(NO_3)_2$+Aq sat. at 15° contains 461·49 g. $Pb(NO_3)_2$ and 928·58 g. H_2O, and has sp. gr. 1·39. (Michel and Krafft, A. ch. (3) **41.** 471.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Pb(NO_3)_2$	t°	Pts. $Pb(NO_3)_2$	t°	Pts. $Pb(NO_3)_2$
0	36·5	36	65·9	72	99·7
1	37·4	37	66·7	73	100·7
2	38·3	38	67·6	74	101·7
3	39·1	39	68·5	75	102·6
4	39·8	40	69·4	76	103·6
5	40·5	41	70·3	77	104·6
6	41·2	42	71·2	78	105·6
7	42·0	43	72·1	79	106·6
8	42·8	44	73·0	80	107·6
9	43·6	45	74·0	81	108·6
10	44·4	46	74·9	82	109·6
11	45·2	47	75·9	83	110·6
12	46·0	48	76·8	84	111·5
13	46·8	49	77·7	85	112·5
14	47·5	50	78·7	86	113·5
15	48·3	51	79·6	87	114·5
16	49·1	52	80·5	88	115·4
17	49·9	53	81·5	89	116·4
18	50·7	54	82·4	90	117·4
19	51·5	55	83·3	91	118·4
20	52·3	56	84·3	92	119·4
21	53·1	57	85·2	93	120·3
22	53·9	58	86·1	94	121·3
23	54·7	59	87·1	95	122·3
24	55·6	60	88·0	96	123·2
25	56·4	61	89·0	97	124·2
26	57·3	62	90·0	98	125·2
27	58·1	63	90·9	99	126·1
28	59·0	64	91·9	100	127·0
29	59·8	65	92·8	101	128·0
30	60·7	66	93·8	102	128·9
31	61·6	67	94·8	103	129·9
32	62·4	68	95·7	104	130·9
33	63·3	69	96·7	104·7	131·5
34	64·1	70	97·7	...	...
35	65·0	71	98·7	...	...

(Mulder, Scheik. Verhandel. **1864**. 66.)

Sp. gr. of $Pb(NO_3)_2+Aq$ sat. at 8°=1·372. (Anthon.)

Sp. gr. of $Pb(NO_3)_2+Aq$ at 17·5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
1	1·0080	20	1·1902
2	1·0163	21	1·2016
3	1·0247	22	1·2132
4	1·0331	23	1·2251
5	1·0416	24	1·2372
6	1·0502	25	1·2495
7	1·0591	26	1·2620
8	1·0682	27	1·2747
9	1·0775	28	1·2876
10	1·0869	29	1·3907
11	1·0963	30	1·3140
12	1·1059	31	1·3276
13	1·1157	32	1·3416
14	1·1257	33	1·3558
15	1·1359	34	1·3702
16	1·1463	35	1·3848
17	1·1569	36	1·3996
18	1·1677	37	1·4146
19	1·1788	...	...

(Schiff, calculated by Gerlach, Z. anal. **8**. 286.)

Sp. gr. of $Pb(NO_3)_2+Aq$ at 19·5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
5	1·045	25	1·266
10	1·093	30	1·334
15	1·144	35	1·414
20	1·203	...	...

(Kremers, calculated by Gerlach, Z. anal. **8**. 286.)

Sp. gr. of $Pb(NO_3)_2+Aq$ at 17·5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
5	1·044	25	1·263
10	1·092	30	1·333
15	1·144	35	1·409
20	1·200	sat. sol.	1·433

(Gerlach, Z. anal. **27**. 283.)

Sat. $Pb(NO_3)_2+Aq$ boils at 103·5°. (Kremers.)

Sat. $Pb(NO_3)_2+Aq$ boils at 102·2°, and contains 140 pts. $Pb(NO_3)_2$ to 100 pts. H_2O. (Griffiths.)

Sat. $Pb(NO_3)_2+Aq$ boils at 103·5°. (Gerlach, Z. anal. **26**. 427.)

B.-pt. of $Pb(NO_3)_2+Aq$ containing pts. $Pb(NO_3)_2$ to 100 pts. H_2O, according to Gerlach (Z. anal. **26**. 449.)

B.-pt.	Pts. $Pb(NO_3)_2$	B.-pt.	Pts. $Pb(NO_3)_2$
100·5°	11	102·5°	87
101	26	103	111
101·5	44	103·5	137
102	65	...	...

Insol. in conc. HNO_3+Aq.

Sol. in sat. KNO_3+Aq without pptn., 100 pts. H_2O at 18·75° dissolving 114 pts. mixed salt, viz. 84·1 pts. $Pb(NO_3)_2$ and 29·9 pts. KNO_3. (Karsten.)

Sol. in sat. $NaNO_3+Aq$ without pptn., 100 pts. H_2O at 18·75° dissolving 121·9 pts. mixed salt, viz. 87·8 pts. $Pb(NO_3)_2$ and 34·1 pts. $NaNO_3$. (Karsten.)

Also sol. in KNO_3+NaNO_3+Aq.

Sol. in sat. $Ba(NO_3)_2+Aq$ with pptn. of $Ba(NO_3)_2$.

100 pts. H_2O dissolve 119·6 pts. $Pb(NO_3)_2$ and 67·1 pts. KNO_3 at 21·2°. (Rüdorff, B. **6**. 484.)

100 pts. sat. $Pb(NO_3)_2+Sr(NO_3)_2+Aq$ contain 45·98 pts. of the two salts at 19·20°. (v. Hauer, J. pr. **98**. 137.)

100 pts. alcohol of 0·9282 sp. gr. dissolve :

at 4°	8°	22°	40°	50°
4·96	5·82	8·77	12·8	14·9 pts. $Pb(NO_3)_2$.

(Gerardin, A. ch. (4) **5**. 129.)

100 pts. absolute methyl alcohol dissolve 1·37 pts. at 20·5°.

100 pts. absolute ethyl alcohol dissolve 0·04 pt. at 20·5°. (de Bruyn. Z. phys. Ch. **10.** 783.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Lead mercurous nitrate, $2PbO, 2Hg_2O, 3N_2O_5$.

Decomp. by H_2O. Sol. in warm dil. HNO_3, or $Hg_2(NO_3)_2+Aq$ without decomp. (Städeler, A. **87.** 129.)

Lead silver nitrate, $Pb(NO_3)_2, 2AgNO_3$.

Sol. in H_2O. (Stürenberg, Pogg. **74.** 115.)

Lead silver nitrate iodide, $Pb(NO_3)_2, 8AgNO_3, 4AgI$.

Decomp. by H_2O. (Stürenberg.)

$Pb(NO_3)_2, 2AgNO_3, 2AgI$. Decomp. by H_2O. (Stürenberg.)

Lead nitrate nitrite, basic, $4PbO, N_2O_5, N_2O_3+2H_2O=Pb(OH)NO_3, Pb(OH)NO_2$.

Sl. sol. in cold, easily in hot H_2O. Sol. in 80 pts. H_2O at 23° (Chevreuil); 85 pts. at ord. temp. (Bromeis, A. **72.** 38); 10·6 pts. at 100° (Chevreuil).

Formula is $3Pb(OH)NO_3, 5Pb(OH)NO_2+H_2O$. (v. Lorenz, W. A. B. **84, 2.** 1133.)

$+3H_2O$. (v. Lorenz.)

$4PbO, N_2O_5, 3N_2O_3+4H_2O$. Sol. in H_2O. (Bromeis.)

$6PbO, N_2O_5, 2N_2O_3+3\frac{2}{3}H_2O=Pb(OH)NO_3, 2Pb(OH)NO_2+\frac{1}{3}H_2O$. (v. Lorenz.)

$6PbO, 2N_2O_5, N_2O_3+3\frac{2}{3}H_2O=2Pb(OH)NO_3, Pb(OH)NO_2+\frac{1}{3}H_2O$. (v. Lorenz.)

$7PbO, N_2O_3, N_2O_5+3H_2O$. Less sol. in H_2O than $4PbO, N_2O_5, N_2O_3+2H_2O$; sol. in cold conc. HNO_3+Aq. (Peligot, A. **39.** 338.)

$8PbO, N_2O_5, 3N_2O_3+4\frac{2}{3}H_2O=Pb(OH)NO_3, 3Pb(OH)NO_2+\frac{1}{3}H_2O$. (v. Lorenz.)

$10PbO, N_2O_5, 4N_2O_3+5H_2O=Pb(OH)NO_3, 4Pb(OH)NO_2$. (v. Lorenz.)

$12PbO, N_2O_5, 5N_2O_3+6H_2O=Pb(OH)NO_3, 5Pb(OH)NO_2$. (v. Lorenz.)

$10PbO, N_2O_5, 2N_2O_3+4H_2O=Pb(OH)NO_3, 2Pb(OH)NO_2, 2PbO+\frac{1}{2}H_2O$. (v. Lorenz.)

$14PbO, N_2O_5, 3N_2O_3+6H_2O=Pb(OH)NO_3, 3Pb(OH)NO_2, 3PbO+H_2O$. (Bromeis.)

$14PbO, 3N_2O_5, N_2O_3+6H_2O=3Pb(OH)NO_3, Pb(OH)NO_2, 3PbO+H_2O$. (Bromeis.)

$16PbO, 2N_2O_5, 3N_2O_3+6H_2O=4Pb(OH)NO_3, 6Pb(OH)NO_2, 5PbO, Pb(OH)_2$. (v. Lorenz.)

$16PbO, 3N_2O_5, 5N_2O_3+10H_2O=3Pb(OH)NO_3, 5Pb(OH)NO_2+H_2O$. (v. Lorenz.)

$26PbO, 6N_2O_5, 7N_2O_3+21H_2O=6Pb(OH)NO_3, 7Pb(OH)NO_2+4H_2O$. (v. Lorenz.)

Lead nitrate phosphate, $Pb(NO_3)_2, Pb_3(PO_4)_2+2H_2O$.

Completely insol. in cold H_2O. Decomp. by boiling H_2O into its constituents. Sol. in a little conc. HNO_3+Aq without decomp. (Gerhardt, A. **72.** 83.)

Lead nitrate phosphite, $Pb(NO_3)_2, PbHPO_3$.

Decomp. by H_2O. Sol. in $Pb(NO_3)_2+Aq$.

$Pb(NO_3)_2+Aq$ (33·3 g. per litre) dissolves 1 g. salt at 15°. If less than 31 g. per litre of $Pb(NO_3)_2$ are present the salt is decomp. (Amat, A. ch. (6) **24.** 317.)

Lead nitrate potassium nitrite, $Pb(NO_3)_2, 2KNO_2+H_2O$.

Difficultly sol. in H_2O. (Lang, J. B. **1862.** 102.)

$3PbO, 3K_2O, 4N_2O_3, 2N_2O_5+3H_2O$. Sol. in H_2O. (Hayes, Sill. Am. J. (2) **31.** 226.)

Lithium nitrate, $LiNO_3$.

Very deliquescent, and sol. in H_2O.

100 pts. H_2O dissolve:

at	0°	20°	40°	70°	100°	110°
	48·3	75·7	169·4	196·1	227·3	256·4 pts. $LiNO_3$.

(Kremers, Pogg. **99.** 47.)

Forms supersaturated solutions with ease, which crystallise when temp. is lowered to +1°. (Kremers, Pogg. **92.** 520.)

Sat. solution boils at over 200°. (Kremers, Pogg. **99.** 43.)

Sp. gr. of $LiNO_3+Aq$ at 19·5° containing pts. $LiNO_3$ in 100 pts. H_2O:

12·7	14·2	26·4	41·8 pts. $LiNO_3$,
1·069	1·077	1·134	1·197
54·8	57·5	77·4	79·4 pts. $LiNO_3$.
1·245	1·255	1·315	1·319

(Kremers, Pogg. **114.** 45.)

1 pt. $LiNO_3$ dissolves in 200 pts. HNO_3. (Schultz, Zeit. Ch. (2) **5.** 531.)

Sol. in strong alcohol.

$+5H_2O$ (?). (Troost, A. ch. (3) **51.** 134.)

Magnesium nitrate, basic, $Mg_3N_2O_8$.

Insol. in H_2O and alcohol. Sol. in acids. (Chodnew, A. **71.** 241.)

Magnesium nitrate, $Mg(NO_3)_2$.

Anhydrous. Deliquescent.

Sol. in 1 pt. H_2O at 15·6°. Sol. in 4 pts. abs. alcohol at 15·6°, and 2 pts. at boiling temp. More sol. in alcohol of 0·817 sp. gr. than in that of 0·900. (Kirwan.)

Sol. in 0·3458 pt. strong alcohol at 82·5°. (Wenzel.)

Sol. in 10 pts. strong alcohol at 15°. (Bergmann.)

Sol. in 9 pts. strong alcohol on heating. (Bergmann.)

$+6H_2O$. Deliquescent. Sol. in H_2O and alcohol. Sol. in 0·5 pt. cold H_2O, and 9 pts. cold alcohol of 0·84 sp. gr.; very sl. sol. in abs. alcohol. (Graham.)

Sp. gr. of $Mg(NO_3)_2+Aq$ at 14°.

% $Mg(NO_3)_2, 6H_2O$.	Sp. gr.	% $Mg(NO_3)_2, 6H_2O$.	Sp. gr.
1	1·0034	30	1·1347
5	1·0202	35	1·1649
10	1·0418	40	1·1909
15	1·0639	45	1·2176
20	1·0869	49	1·2397
25	1·1103	...	...

(Oudemans, Z. anal. **7.** 419.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 21°.

% $Mg(NO_3)_2$ $+6H_2O$.	Sp. gr.	% $Mg(NO_3)_2$ $+6H_2O$.	Sp. gr.
2	1·0078	28	1·1216
4	1·0158	30	1·1312
6	1·0239	32	1·1410
8	1·0321	34	1·1508
10	1·0405	36	1·1608
12	1·0490	38	1·1709
14	1·0577	40	1·1811
16	1·0663	42	1·1914
18	1·0752	44	1·2019
20	1·0843	46	1·2124
22	1·0934	48	1·2231
24	1·1026	50	1·2340
26	1·1120	...	...

(Schiff, calculated by Gerlach, Z. anal. **8.** 286.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 18°.

% $Mg(NO_3)_2$.	Sp. gr.	% $Mg(NO_3)_2$.	Sp. gr.
5	1·0378	15	1·1181
10	1·0763	17	1·1372

(Kohlrausch, W. Ann. **1879.** 1.)

Melts in its crystal H_2O at 90°, and the resulting liquid boils at 143·4°. (Ordway, Sill. Am. J. (2) **27.** 14.)

Less sol. in $Ca(NO_3)_2$ + Aq than in H_2O. (Dijonval.)

Min. *Nitromagnesite.*

Manganous nitrate, basic, $2MnO, N_2O_5+3H_2O$.

Sol. in H_2O. (Gorgeu.)

Manganous nitrate, $Mn(NO_3)_2+6H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Sp. gr. of $Mn(NO_3)_2$+Aq at 8°.

% $Mn(NO_3)_2$ $+6H_2O$	Sp. gr.	% $Mn(NO_3)_2$ $+6H_2O$	Sp. gr.
5	1·0253	45	1·2705
10	1·0517	50	1·3074
15	1·0792	55	1·3459
20	1·1078	60	1·3861
25	1·1137	65	1·4281
30	1·1688	70	1·4721
35	1·2012	71	1·4811
40	1·2352	...	...

(Oudemans, Z. anal. **7.** 421.)

Sp. gr. of aqueous solutions containing:

10	20	30	40	% $Mn(NO_3)_2+6H_2O$,
6·237	12·474	18·711	24·948	% $Mn(NO_3)_2$,
1·052	1·107	1·165	1·230	
50	60	70	80	% $Mn(NO_3)_2+6H_2O$.
31·185	37·422	43·659	49·896	% $Mn(NO_3)_2$.
1·302	1·381	1·466	1·558	

(Gerlach, Z. anal. **28.** 477.)

Melts in its crystal H_2O at 25·8° and boils at 129·4°. (Ordway.)

$+3H_2O$. From solution in HNO_3. (Schultz-Sellack, Zeit. Ch. **1870.** 646.)

Mercurous nitrate, basic, $2Hg_2O, N_2O_5+H_2O$.

Ppt. Decomp. by boiling with H_2O. (Marignac, A. ch. (3) **27.** 332.)

Slowly sol. in cold, rapidly in hot HCl + Aq; insol. in NH_4Cl, and NH_4NO_3 + Aq.

$5Hg_2O, 3N_2O_5+2H_2O$. (Marignac.) Is $2Hg_2O, N_2O_5+H_2O$. (Lefort, A. **56.** 247.) Sol. in boiling, less sol. in cold H_2O. (Marignac, *l.c.*)

$4Hg_2O, 3N_2O_5+H_2O$. Sol. in a small quantity of H_2O; decomp. by a large amt. of H_2O or by warm H_2O. (Rose, Pogg. **83.** 154.)

Is $3HgO, 2N_2O_5+H_2O$ according to Gerhardt.

Mercurous nitrate, $Hg_2(NO_3)_2+2H_2O$, or $HgNO_3+H_2O$.

Completely sol. in a little warm H_2O, but decomp. by more H_2O. Completely sol. as acid salt in H_2O containing HNO_3. (Marignac, A. ch. (3) **27.** 332.)

Mercuric nitrate, basic, $6HgO, N_2O_5$ (?).

Insol. in hot H_2O. (Kane.)

$3HgO, N_2O_5+H_2O$. Decomp. to oxide by washing with cold H_2O. Sol. in dil. HNO_3 + Aq. (Millon, A. ch. (3) **18.** 361.)

$2HgO, N_2O_5+H_2O$. Sl. deliquescent. Decomp. by H_2O; sol. in dil. HNO_3 + Aq. (Millon.)

$+2H_2O$. Decomp. by cold H_2O. Deliquescent. Sol. in H_2O containing HNO_3. (Marignac.)

$+3H_2O$. (Ditte, J. B. **1854.** 366.)

Mercuric nitrate, $Hg(NO_3)_2+\frac{1}{2}H_2O$.

Deliquescent. Very sol. in a little H_2O. H_2O precipitates basic salt from conc. $Hg(NO_3)_2$ + Aq. Insol. in alcohol. Decomp. by ether. (Millon.)

$+8H_2O$. Melts at 6° in crystal H_2O. (Ditte.)

Mercurosomercuric nitrate, $Hg_2O, 2HgO, N_2O_5$.

Boiling H_2O gradually dissolves out $Hg_2(NO_3)_2$, and leaves residue of HgO and Hg. (Brooks, Pogg. **66.** 63.)

Mercuric silver nitrate, $Hg(NO_3)_2, 2AgNO_3$.

Easily sol. in H_2O without decomp. (Berzelius.)

Mercurous strontium nitrate, $2SrO, 2Hg_2O, 3N_2O_5$.

Decomp. by H_2O. Much more sol. in H_2O than the corresponding Ba compound.

Readily sol. in warm dil. HNO_3 + Aq or $Hg_2(NO_3)_2$ + Aq without decomposition. (Städeler, A. **87.** 131.)

Mercuric nitrate iodide, $Hg(NO_3)_2, 2HgI_2$.

Decomp. by long boiling with H_2O. (Riegel, Jahrb. Pharm. **11.** 396.)

$2Hg(NO_3)_2, 3HgI_2$. Easily decomp. by H_2O; less easily by alcohol or ether. (Riegel.)

$Hg(NO_3)_2$, HgI_2. Decomp. very quickly by HNO_3+Aq or alcohol of 0·814 sp. gr. (Souville, J. Pharm. **26.** 474.)

Mercurous nitrate phosphate, $HgNO_3$, $Hg_3PO_4+H_2O$.

Insol. in H_2O, but decomp. by boiling therewith. Insol. in H_3PO_4+Aq or alcohol. Completely sol. in hot NH_4Cl+Aq. Decomp. by cold KOH+Aq, and warm K_2CO_3+Aq. (Wittstein.)

$2HgNO_3$, Hg_2O, $5Hg_3PO_4+H_2O$. (Haack, A. **262.** 192.)

Mercuric nitrate silver iodide, $Hg(NO_3)_2$, $2AgI+\frac{1}{2}H_2O$.

Decomp. by H_2O. (Preuss, A. **29.** 328.)

Molybdenum nitrate, Mo_2O_3, N_2O_5 (?).

Sol. in dil. HNO_3+Aq. (Berzelius.)

MoO_2, $2N_2O_5$ (?). Sol. in dil. HNO_3+Aq. (Berzelius.)

Mercuric nitrate sulphide, $Hg(NO_3)_2$, 2HgS.

Very sl. sol. in hot H_2O. Insol. in HNO_3+Aq. Decomp. by hot H_2SO_4 or aqua regia, also by hot HCl+Aq. (Barfoed, J. pr. **93.** 230.)

$2Hg(NO_3)_2$, HgO, $6HgS+12H_2O$. Insol. in H_2O, and HNO_3+Aq of 1·2 sp. gr. (Gramp, J. pr. (2) **14.** 299.)

Nickel nitrate, basic.

Insol. in H_2O. (Proust.)

8NiO, $2N_2O_5+5H_2O$. Insol. in cold or hot H_2O. (Habermann, M. **5.** 432.)

5NiO, $N_2O_5+4H_2O$. Not decomp. by boiling H_2O. (Rousseau and Tite, C. R. **114.** 1184.)

Nickel nitrate, $Ni(NO_3)_2+6H_2O$.

Not deliquescent in dry air. Sol. in 2 pts. cold H_2O and in alcohol. (Tupputi.)

Sp. gr. of aqueous solution at 17·5° containing:

5	10	15	20	% $Ni(NO_3)_2$,
1·0463	1·0903	1·1375	1·1935	
25	30	35	40	% $Ni(NO_3)_2$.
1·2534	1·3193	1·3896	1·4667	

(Franz, J. pr. (2) **5.** 295.)

M.-pt. of $Ni(NO_3)_2+6H_2O$=56·7°. (Ordway; Tilden, Chem. Soc. **45.** 409.)

Sat. solution boils at 136·7°. (Ordway.)

Sp. gr. of $Ni(NO_3)_2$+Aq containing in 1000 g. H_2O at 24·4°, x g. $Ni(NO_3)_2+6H_2O$.

145·5 g. (=½ mol.)	291	436·5	582
1·069	1·128	1·179	1·224
727·5	873	1018·5	1164
1·264	1·299	1·329	1·357

Containing g. $Ni(NO_3)_2$ (anhydrous):

91·5 g. (=½ mol.)	183	274·5	369	460·5	549
1·073	1·141	1·205	1·266	1·324	1·378

(Gerlach, Z. anal. **28.** 468.)

Sol. in NH_4OH+Aq.

Insol. in absolute alcohol. Sl. sol. in acetone. (Krug and M'Elroy.)

Nickel nitrate ammonia, $Ni(NO_3)_2$, $4NH_3+2H_2O$.

Efflorescent. Easily sol. in cold H_2O; decomp. by boiling. Insol. in alcohol. (Erdmann, J. pr. **97.** 395.)

$Ni(NO_3)_2$, $6NH_3+1\frac{1}{2}H_2O$. (André, C. R. **106.** 936.)

Nickel nitrate chloride ammonia, $6Ni(NO_3)_2$, $NiCl_2$, $30NH_3+16H_2O$.

Sol. in H_2O with decomp. (Schwarz, W. A. B. **1850.** 272.)

Palladium nitrate, basic, $Pd(NO_3)_2$, 3PdO, $+4H_2O$.

Ppt. Insol. in H_2O. (Kane.)

Palladium nitrate, $Pd(NO_3)_2+xH_2O$.

Very deliquescent, and sol. in H_2O. Decomp. by much H_2O or alcohol. (Kane.)

Decomp. by cold or hot H_2O. (Rose, A. **83.** 143.)

Platinic nitrate, $Pt(NO_3)_4$ (?).

Known only in solution, which is decomp. on evaporating. (Berzelius.)

$Pt(NO_3)_2$, $3PtO_2+5H_2O$. Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Potassium nitrate, KNO_3.

Not deliquescent, but, according to Mulder, 100 pts. KNO_3 under a bell jar with H_2O take up 339 pts. H_2O in 22 days, and small amounts finally deliquesce completely.

Sol. in H_2O with absorption of heat.

16 pts. KNO_3+100 pts. H_2O at 13·2° lower the temperature 10·2°. If the initial temp. is 23° it falls to 12·8°, if 0° it does not fall below −2·7°, which is the freezing-point of the mixture. (Rüdorff, Pogg. **136.** 276.)

KNO_3+Aq sat. at 18·1° has 1·1601 sp. gr. and contains 22·72 % KNO_3, or 100 pts. H_2O at 18·1° dissolve 29·45 pts. KNO_3. (Karsten, **1840.**)

Sol. in 3·745 pts. H_2O at 15°. (Gerlach.)

Sol. in 3 pts. H_2O at 21° (Schiff, A. **109.** 326), and solution has 1·1683 sp. gr.

Sol. in 3 pts. cold, and 0·5 pt. boiling H_2O. (Fourcroy.)

KNO_3+Aq sat. at 18° has sp. gr. 1·151, and contains 21·63 % KNO_3, or 100 pts. H_2O dissolve 27·60 pts. KNO_3 at 18°. (Longchamp.)

Sol. in 4 pts. H_2O at 16°, and 0·25 pt. at b.-pt. (Riffault.)

100 pts. H_2O at 114·5° dissolve 284·61 pts. (Griffiths.)

Sol. in 7 pts. cold, and 1 pt. boiling H_2O. (Bergmann.)

Sol. in 6·15 pts. cold H_2O at 18·75°. (Abl.)

100 pts. H_2O at 15·5° dissolve 26·6 pts.; at 100°, 100 pts. (Ure's Dictionary.)

KNO_3+Aq sat. at 10° contains 33·3 %. (Eller.)

KNO_3+Aq sat. in the cold contains 25 %. (Fourcroy.)

KNO_3+Aq sat. at 12·5° contains 24·8 %. (Hassenfratz.)

Solubility of KNO_3 in 100 pts. H_2O at t°.

t°	Pts. KNO_3	t°	Pts. KNO_3
0	13·2	45·10	74·7
5	16·7	54·72	97·1
11·67	22·2	65·45	125·5
17·91	29·3	79·72	169·2
24·94	38·4	97·66	236·4

(Gay-Lussac, A. ch. **11.** 314.)

Solubility of KNO_3 in 100 pts. H_2O at t°.

t°	Pts. KNO_3
16·0	26·7
29	43·5
44·2	71·4

(Nordenskjöld, Pogg. **136.** 312.)

100 pts. H_2O dissolve at :

10°	18°	27°	41°	53°
21·2	27·9	40·1	66·3	93·3 pts. KNO_3.

(Gerardin, A. ch. (4) **5.** 150.)

100 pts. $KNO_3 + Aq$ sat. at 14° contain 16·34 pts. KNO_3; at 15°, 18·81 pts. KNO_3. (v. Hauer, J. pr. **98.** 177.)

100 pts. H_2O dissolve at :

4°	16·3°	68·3°
16	27·2	132·1 pts. KNO_3.

(Andreae, J. pr. (2) **29.** 456.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. KNO_3	t°	Pts. KNO_3	t°	Pts. KNO_3
0	13·3	39	62	78	165
1	13·8	40	64	79	168
2	14·6	41	66	80	172
3	15·5	42	68	81	175
4	16·4	43	70	82	179
5	17·1	44	72	83	182
6	17·8	45	74	84	185
7	18·5	46	76	85	189
8	19·3	47	78	86	192
9	20·2	48	81	87	196
10	21·1	49	83	88	199
11	22·0	50	86	89	203
12	23·0	51	88	90	206
13	24·0	52	91	91	210
14	25·0	53	93	92	214
15	26·0	54	96	93	218
16	27·0	55	98	94	222
17	28·1	56	101	95	226
18	29·1	57	103	96	230
19	30·2	58	106	97	234
20	31·2	59	108	98	238
21	32·3	60	111	99	243
22	33·5	61	113	100	247
23	34·7	62	116	101	252
24	36·0	63	119	102	256
25	37·3	64	121	103	261
26	38·6	65	124	104	266
27	40·0	66	127	105	272
28	41·4	67	130	106	278
29	42·9	68	133	107	284
30	44·5	69	136	108	289
31	46·0	70	139	109	295
32	48	71	142	110	301
33	50	72	146	111	307
34	52	73	149	112	313
35	54	74	152	113	319
36	56	75	155	114	326
37	58	76	159	114·1	327·4
38	60	77	162	...	...

(Mulder, Scheik. Verhandel. **1864.** 89.)

100 pts. H_2O dissolve 493 pts. KNO_3 at 125°. (Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Rhombohedral KNO_3 is more easily soluble than the prismatic, and easily forms supersaturated solutions. (Frankenheim.)

Sp. gr. of solution sat. at 15°=1·134. (Michel and Krafft.)

Sp. gr. of solution sat. at 16°=1·138. (Stolba, J. pr. **97.** 503.)

Sp. gr. of solution sat. at 18°=1·1601, and contains 29·45 % KNO_3. (Karsten.)

Sp. gr. of $KNO_3 + Aq$ at 19·5°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
4·871	1·0307	17·965	1·1198
9·618	1·0618	21·488	1·1457
14·044	1·0920	...	...

(Kremers, Pogg. **95.** 120.)

Sp. gr. of $KNO_3 + Aq$ at 21°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1·0058	13	1·0819
2	1·0118	14	1·0887
3	1·0178	15	1·0956
4	1·0239	16	1·1026
5	1·0300	17	1·1097
6	1·0363	18	1·1169
7	1·0425	19	1·1242
8	1·0490	20	1·1316
9	1·0555	21	1·1390
10	1·0621	22	1·1464
11	1·0686	23	1·1538
12	1·0752	24	1·1613

(Schiff, A. **110.** 75.)

Sp. gr. of $KNO_3 + Aq$ at 15°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1·00641	12	1·07905
2	1·01283	13	1·08596
3	1·01924	14	1·09286
4	1·02566	15	1·09977
5	1·03207	16	1·10701
6	1·03870	17	1·11426
7	1·04534	18	1·12150
8	1·05197	19	1·12875
9	1·05861	20	1·13599
10	1·06524	21	1·14361
11	1·07215	...	...

(Gerlach, Z. anal. 8. 286.)

Sp. gr. of $KNO_3 + Aq$ at 17·5°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1·006	8	1·051	15	1·099
2	1·012	9	1·058	16	1·106
3	1·019	10	1·065	17	1·113
4	1·025	11	1·072	18	1·120
5	1·032	12	1·078	19	1·127
6	1·038	13	1·085	20	1·134
7	1·045	14	1·092	...	...

(Hager, Comm. **1883.**)

Sp. gr. of KNO_3+Aq at 18°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
5	1·0305	20	1·133
10	1·0632	22	1·148
15	1·097	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of KNO_3+Aq at 20°, containing mols. KNO_3 in 100 mols. H_2O.

Mols. KNO_3	Sp. gr.	Mols. KNO_3	Sp. gr.
0·5	1·01730	4	1·12264
1	1·03373	5	1·14888
2	1·06524	...	...

(Nicol, Phil. Mag. (5) **16.** 122.)

The saturated solution boils at 114·1° (Mulder); 114·5° (Griffiths); 115·9° (Legrand, Gerardin); 117° (Magnus); 118° (Kremers); 126° (Le Page).

The saturated solution forms a crust at 111°, and boils at 115°; highest temp. observed, 115·3°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of KNO_3+Aq containing pts. KNO_3 to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 444); L=according to Legrand (A. ch. (2) **52.** 426).

B.-pt.	G	L	B.-pt.	G	L
100·5°	7·5	...	107°	120·5	119·0
101	15·2	12·2	108	141·5	140·6
101·5	23	...	109	164	163·0
102	31	26·4	110	188·5	185·9
102·5	39	...	111	215	209·2
103	47·5	42·2	112	243	233·0
103·5	56	...	113	274	257·6
104	64·5	59·6	114	306	283·3
104·5	73	...	115	338·5	310·2
105	82	78·3	115·9	...	335·1
106	101	98·2	...	...	...

1 pt. KNO_3 dissolves in 1·4 pts. HNO_3; at 20° in 3·8 pts., and at 123° in 1 pt. HNO_3+Aq of 1·423 sp. gr. (Composition $2HNO_3, 3H_2O$.) (Schultz, Zeit. Ch. (2) **5.** 531.)

Sol. in 20% $KC_2H_3O_2$+Aq. (Stromeyer.)

Sol. in sat. NH_4NO_3+Aq, at first without pptn., but afterwards NH_4NO_3 is pptd. (Karsten.)

Sol. in NH_4NO_3+Aq with pptn. of NH_4NO_3. (Rüdorff, B. **6.** 485.) (See also NH_4NO_3.)

Sol. in sat. $Ba(NO_3)_2$+Aq, but soon a double salt separates. (Karsten.)

Sol. in $Ca(NO_3)_2$+Aq. (Longchamp.)

Sol. in sat. $Pb(NO_3)_2$+Aq without pptn.

100 pts. H_2O dissolve 119·6 pts. $Pb(NO_3)_2$ and 67·1 pts. KNO_3 at 21·2°. (Rüdorff, B. **6.** 484.) (See also $Pb(NO_3)_2$.)

KNO_3 and $NaNO_3$.

100 pts. H_2O dissolve 34·53 pts. KNO_3 and 91·16 pts. $NaNO_3$ at 15·6°, and solution has sp. gr.=1·478. (Page and Keightley.)

100 pts. KNO_3+$NaNO_3$+Aq sat. at 14° contain 52·17 pts. of the two salts; sat. at 13° contain 53·15 pts. of the two salts. (v. Hauer.)

100 pts. H_2O dissolve at 18·75° 29·45 pts. KNO_3 and 89·53 pts. $NaNO_3$, if sat. KNO_3+Aq is treated with $NaNO_3$, and 35·79 pts. KNO_3 and 88·00 pts. $NaNO_3$ by the opposite process. 134·38 pts. of the two salts are dissolved if a mixture of the salts is treated with H_2O at 18·75°. (Karsten.)

100 pts. H_2O dissolve 39·34 pts. KNO_3 and 94·60 pts. $NaNO_3$, or 133·94 pts. of the two salts at 20°. (Nicol, Phil. Mag. (5) **13.** 385.)

Solubility of mixtures of KNO_3 and $NaNO_3$.

% $NaNO_3$ in mixture before solution	Total amt. mixed salts dissolved in 100 pts. H_2O at 20	Pts. $NaNO_3$ dissolved	Pts. KNO_3 dissolved	% $NaNO_3$ in mixture after solution and evap. to dryness
100	86·8	86·8	0	100
90	109·6	96·4	13·2	88
80	136·5	98·0	38·5	71·8
70	136·3	...	...	...
60	137·6	90·0	47·6	65·4
50	106·1	66·0	40·1	62·2
45·7*	88·0	53·3	34·7	60·6
40	81·1	45·6	35·6	56·2
30	73·5	...	...	...
20	54·1	20·8	33·3	38·5
10	40·9	9·4	31·5	22·9
0	33·6	0	33·6	0

* $NaNO_3$+KNO_3.

(Carnelley and Thomson, Chem. Soc. **53.** 782.)

100 pts. H_2O dissolve 28·92 pts. KNO_3, 53·68 pts. $NaNO_3$, and 26·44 pts. NaCl at 15·6°, and solution has sp. gr.=1·44. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

KNO_3 and KCl.

100 pts. H_2O dissolve pts. of the two salts:

	At 12·9°	At 15·3°
KNO_3 . .	18·8	18·9
KCl . . .	28·5	29·8

(Kopp.)

100 pts. H_2O dissolve 315·2 pts. KCl and 19·1 pts. KNO_3 at 20·0°. (Rüdorff, B. **6.** 484.)

100 pts. H_2O dissolve 18·95 pts. KNO_3+32·84 pts. KCl, or 51·79 pts. of the mixed salts at 20°. (Nicol, Phil. Mag. (5) **31.** 385.)

Solubility of KCl with addition of KNO_3 at 17·5°.

Sp. gr.	100 ccm. of solution contain g.		
	KCl	H_2O	KNO_3
1·1730	29·39	87·85	0
1·1980	27·50	85·68	6·58
1·2100	27·34	84·76	8·83
1·2250	26·53	83·58	12·48
1·2360	25·98	82·84	14·83
1·2390	25·96	82·65	15·22
1·2388	25·95	82·43	15·49
1·2410	26·24	82·63	15·33

KNO_3 separated out in last four solutions.

Solubility of KNO_3 with addition of KCl at 20·5°.

Sp. gr.	100 ccm. of solution contain g.		
	KNO_3	H_2O	KCl
1·1625	27·68	88·51	0
1·1700	24·39	87·89	4·72
1·1765	22·44	87·47	7·74
1·1895	20·23	86·48	12·23
1·1983	18·96	85·69	15·15
1·2150	17·67	84·23	19·61
1·2265	17·11	83·40	22·17
1·2400	16·79	82·24	24·96

(Bodländer, Z. phys. Ch. **7**. 359.)

Sol. in sat. NH_4Cl+Aq. Solution thus obtained contains 43·07 pts. mixed salts, or 100 pts. H_2O dissolve 75·66 pts. mixed salts, viz. 38·62 pts. KNO_3 and 39·84 pts. NH_4Cl. (Karsten.) (See also NH_4Cl.)

Sol. in sat. $BaCl_2+Aq$ with pptn. of $Ba(NO_3)_2$.

KNO_3 and NaCl.

NaCl is sol. in sat. KNO_3+Aq, and the mixed solution is capable of dissolving more KNO_3. An amount of H_2O, which, when pure, could only dissolve 100 pts. KNO_3, can in this way be made to take up 152·64 pts. (Longchamp, A. ch. (2) **9**. 8.)

Sol. in sat. NaCl + Aq.

100 pts. H_2O dissolve :

	Longchamp 4° (1)	Rüdorff 14° (2)	Rüdorff 18° (3)	Page and Keightley 15·6° (4)
NaCl	35·96	38·5	38·9	39·57
KNO_3	26·01	28·7	36·1	32·32
	61·97	67·2	75·0	71·89

	Karsten 18·75° (5)	Karsten 18·75° (6)	Karsten 18·75° (7)	Mulder At b.-pt. (8)
NaCl	36·53	38·25	39·19	37·9
KNO_3	33·12	29·45	38·53	306·7
	69·65	67·70	77·72	344·6

1, 2, 3, 4, and 8. Both salts in excess.

5. Sat. NaCl + Aq treated with KNO_3.

6. Sat. KNO_3+Aq treated with NaCl.

7. The two salts simultaneously treated with H_2O.

100 pts. H_2O dissolve 31·44 pts. KNO_3, 139 pts. KCl, and 38·58 pts. NaCl at 15·6°, and solution has sp. gr. = 1·33. (Page and Keightley.)

KNO_3 and K_2SO_4.

Sat. KNO_3+Aq dissolves some K_2SO_4, and sat. K_2SO_4+Aq slowly dissolves some KNO_3 without pptn., but K_2SO_4 is afterwards pptd. (Karsten.)

100 pts. H_2O dissolve :

	Mulder 18·75° (1)	Karsten 18·75° (2)	Kopp 20° (3)	Kopp 40° (4)	Mulder 18·75° (5)
KNO_3	29·90	29·42	26·9	59·35	...
K_2SO_4	...	4·0	6·6	5·75	10·8

2. H_2O sat. with KNO_3 and K_2SO_4 simultaneously, or to a sat. solution of one salt the other was added.

3 and 4. H_2O sat. with both salts simultaneously.

Mulder doubts the results of 3 and 4.

Slowly sol. in sat. Na_2SO_4 at first without pptn., but afterwards K_2SO_4 or $NaSO_4$ separates out.

Sol. in sat. $CuSO_4+Aq$, forming a double salt, which soon separates out.

Very slowly and slightly sol. in $MgSO_4+Aq$ with pptn. of $MgSO_4$.

Sol. in sat. $ZnSO_4+Aq$ with pptn. of double salt. (Karsten.)

Sol. in sat. $KClO_3+Aq$, from which solution it is not pptd. by salts which would ppt. it from aqueous solution. (Karsten.)

Insol. in absolute alcohol; in dilute alcohol it dissolves proportional to the amount of H_2O present, but always less is dissolved than the H_2O would dissolve by itself. (Gerardin.)

100 pts. alcohol containing % by weight of alcohol dissolve pts. KNO_3 at 15°.

10	20	30	40	50	60	80 % alcohol
13·2	8·5	5·6	4·3	2·8	1·7	0·4 pts. KNO_3.

(Schiff, A. **118**. 365.)

Solubility in 100 pts. alcohol at t°. D = sp. gr. of alcohol ; S = solubility.

D=0·9904		D=0·9848		D=0·9793		D=0·9726	
t°	S	t°	S	t°	S	t°	S
12	18·1	12	14·6	10	10·20	14	8·8
21	25·0	21	21·7	10	10·19	25	13·6
33	40·4	36	37·8	13	11·74	34	20·3
43	58·6	41	45·0	18	14·52	44	31·3
53	79·1	56	72·9	20	16·35	47	34·2
61	94·5	...	...	31	25·81	60	52·3
62	95·7	...	...	34	28·63	...	...
...	...	...	...	40	36·66	...	...
...	...	...	...	41	37·20	...	...
...	...	...	...	50	50·14	...	...
...	...	...	...	53	56·01	...	...
...	...	...	...	61	72·24	...	...
...	...	...	...	62	73·36	...	...

D=0·9573		D=0·9390		D=0·8967		D=0·8429	
t°	S	t°	S	t°	S	t°	S
14	5·4	16	4·13	12	1·61	15	0·29
25	9·0	24	6·00	33	3·62	22	0·39
33	13·2	40	10·94	47	5·77	40	0·62
44	19·1	51	16·51	57	6·97	54	0·78
57	29·1	60	21·54	...	...	60	1·10
65	36·2	64	24·22	...	...	...	...

(Gerardin, A. ch. (4) **5**. 151.)

Solubility of KNO_3 in alcohol at 18°.

Sp. gr.	100 ccm. contain g.		
	Alcohol	Water	KNO_3
1·1475	...	89·63	25·12
1·1085	3·30	87·44	20·11
1·1010	5·24	86·26	18·60
1·0805	8·69	83·18	16·18
1·0655	14·08	77·93	14·54
1·0490	16·27	76·36	12·27
1·0375	19·97	72·93	10·85
0·9935	28·11	64·74	6·50
0·9585	37·53	54·21	4·11
0·9456	42·98	48·15	3·37
0·9050	51·23	27·32	1·95
0·8722	61·65	24·74	0·83
0·8375	69·60	13·95	0·20

(Bodländer, Z. phys. Ch. **7**. 316.)

Almost insol. in ether. (Braconnot.)

100 pts. glycerine (sp. gr. 1·225) dissolve 10 pts. KNO_3. (Vogel, N. Rep. Ph. **16**. 557.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Potassium *di*hydrogen nitrate, KNO_3, $2HNO_3$.

Decomp. by H_2O. (Ditte, A. ch. (5) **18**. 320.)

Potassium silver nitrate, KNO_3, $AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26**. 357.)

$3KNO_3$, $AgNO_3$. Sol. in H_2O. (Rose, Pogg. **106**. 320.)

Potassium nitrate phosphomolybdate.

See **Phosphomolybdate nitrate, potassium.**

Potassium thorium nitrate, $4KNO_3$, $Th(NO_3)_4$.

Very sol. in H_2O and alcohol. (Berzelius.)

Potassium nitrate sulphate, KNO_3, $KHSO_4$.

Decomp. by H_2O and alcohol. (Jacquelain.)

Potassium nitrate sulphotungstate, $2KNO_3$, K_2WS_4 (?).

Very sol. in hot or cold H_2O. Insol. in alcohol. (Berzelius.)

Potassium nitrate tungstate (?).

100 pts. boiling H_2O dissolve 5 pts. salt. (Storer's Dict. p. 393.)

Potassium nitrate zinc iodide.

Permanent. Easily sol. in H_2O. Insol. in alcohol. (Anthon.)

Rhodium nitrate, $Rh(NO_3)_3+2H_2O$ (?).

Deliquescent. Sol. in H_2O. Insol. in alcohol. (Claus.)

Rubidium nitrate, $RbNO_3$.

100 pts. H_2O dissolve 20·1 pts. at 0°; 43·5 pts. at 10°. (Bunsen.)

Easily sol. in HNO_3. (Schultz, Zeit. Ch. (2) **5**. 531.)

Rubidium hydrogen nitrate, $2RbNO_3$, $5HNO_3$.

Decomp. by H_2O. Known only in solution in HNO_3+Aq. (Ditte, A. ch. (5) **18**. 320.)

Rubidium silver nitrate, $RbNO_3$, $AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26**. 357.)

Samarium nitrate, $Sm(NO_3)_3+6H_2O$.

Easily sol. in H_2O. (Cleve, C. N. **48**. 74.)

Scandium nitrate, basic.

Sol. in H_2O. (Nilson, B. **13**. 1444.)

Scandium nitrate, $Sc(NO_3)_3$ (?).

Very sol. in H_2O.

Silver nitrate, $AgNO_3$.

100 pts. H_2O at 11° dissolve 127·7 pts. (Schnauss, Arch. Pharm. (2) **82**. 260.)

100 pts. H_2O dissolve at:

0°	19·5°	54°	85°	110°	
121·9	227·3	500	714	1111	pts. $AgNO_3$.

(Kremers, Pogg. **92**. 497.)

100 pts. H_2O dissolve 1622·5 pts. at 125°, and 1941·4 pts. at 133°. (Tilden and Shenstone, Phil. Trans. **1884**. 23.)

Sat. solution boils at 125°. (Kremers.)

Sp. gr. of aqueous solution, according to C. K. = Chemiker Kalender; K. M. = Kohlrausch by Mendelejeff (Z. anal. **27**. 284); and K = Kohlrausch (W. Ann. **1879**. 1), containing:

	5	10	15	20	25 % $AgNO_3$,
C. K.	1·041	1·080	1·125	1·160	1·206
K. M.	1·0440	1·0901	...	1·1969	...
K.	1·0422	1·0893	1·1404	1·1958	1·2555
	30	35	40	45	50 % $AgNO_3$.
C. K.	1·251	...	...	...	...
K. M.	...	...	1·4791	...	...
K.	1·3213	1·3945	1·4773	1·5705	1·6745

Sol. in 500 pts. HNO_3; 30 pts. $2HNO_3$, $3H_2O$ at 20°; and 6 pts. $2HNO_3$, $3H_2O$ at 100°. (Schultz, Zeit. Ch. **1869**. 531.)

Sol. in 4 pts. boiling alcohol.

Sol. in 10 pts. alcohol. (Dumas.)

Sol. in 11 pts. alcohol of 90 %. (Hager.)

Solubility in 100 pts. alcohol of given vol. % at t°.

t°	95 %	80 %	70 %	60 %
15	3·8	10·3	22·1	30·5
50	7·3	...	...	58·1
75	18·3	42·0	...	89·0

t°	50 %	40 %	30 %	20 %	10 %
15	35·8	56·4	73·7	107	158
50	...	98·3	...	214	...
75	...	160	...	340	...

(Eder, J. pr. (2) **17**. 44.)

100 pts. absolute methyl alcohol dissolve 3·72 pts. at 19°; 100 pts. absolute ethyl alcohol dissolve 3·1 pts. at 19°. (de Bruyn, Z. phys. Ch. **10**. 783.)

Only traces are sol. in absolute alcohol or ether. 100 pts. of a mixture of 1 vol. alcohol (95 vol. %) + 1 vol. pure ether dissolve 1·6 pts.

$AgNO_3$ at 15°; 100 pts. of 2 vols. alcohol +1 vol. ether dissolve 2·3 pts. $AgNO_3$.

100 pts. H_2O sat. with ether dissolve 88·4 pts. $AgNO_3$ at 15°. (Eder, *l.c.*)

Sol. in ether.

Sol. in glycerine.

Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Silver nitrate ammonia, $AgNO_3$, NH_3.

Partly sol. in H_2O; rather sol. in alcohol. Sl. sol. in ether. (Reychler, B. **16.** 990.)

$AgNO_3$, $2NH_3$. Easily sol. in H_2O. (Mitscherlich.)

$AgNO_3$, $3NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20.** 153.)

Silver nitrate antimonide, $AgNO_3$, Ag_3Sb.

Decomp. at once by H_2O. (Poleck and Thümmel, B. **16.** 2435.)

Silver nitrate arsenide, $AgNO_3$, Ag_3As.

Decomp. at once by H_2O. (Poleck and Thümmel.)

Silver nitrate bromide, $AgNO_3$, $AgBr$.

Decomp. immediately by H_2O or alcohol, with separation of AgBr. (Risse, A. **111.** 39.)

Silver nitrate chloride, $AgNO_3$, $AgCl$.

Quickly decomp. with H_2O; more slowly with absolute alcohol; not decomp. by ether-alcohol. (Reichert, J. pr. **92.** 237.)

Silver nitrate iodide, $AgNO_3$, AgI.

Cold H_2O separates AgI, which redissolves on heating. (Stürenberg, Arch. Pharm. (2) **143.** 12.) Sol. in little H_2O without decomp.; more H_2O separates AgI. (Kremers, J. pr. **71.** 54.) Insol. in absolute alcohol. Sol. in conc. $AgNO_3$+Aq.

$2AgNO_3$, AgI. Sol. in little but decomp. by more boiling H_2O. (Risse, A. **111.** 39.)

Silver nitrate phosphide, $3AgNO_3$, Ag_3P.

(Warren, C. N. **56.** 113.)

Silver nitrate silicide, $4AgNO_3$, Ag_4Si.

(Buchner, Ch. Ztg. **9.** 484.)

Silver nitrate silicate, $2AgNO_3$, $3Ag_4SiO_4$.

Sol. in dil. HNO_3+Aq, but SiO_2 separates out after heating. (Rousseau and Tite, C. R. **114.** 294.)

Silver nitrate sulphide, $AgNO_3$, Ag_2S.

Decomp. by H_2O. (Poleck and Thümmel, B. **16.** 2435.)

Sodium nitrate, $NaNO_3$.

Deliquescent in moist air. Sol. in H_2O with absorption of heat. 75 pts. $NaNO_3$ mixed with 100 pts. H_2O at 13·2° lower the temperature 18·5°. (Rüdorff, B. **2.** 68.)

Sol. in 1·58 pts. H_2O at −6°. } (Marx.)
" 0·46 " " +119°. }
" 2·89 " " 2°. }
" 1·12 " " 28°. } (Osann.)
" 0·79 " " 47°. }
" 1·14 " " 18·5°. (Kopp.)
" 1·136 " " 18·75°. (Karsten.)
" 1·16 " " 20°. (Schiff, A. **109.** 326.)
" 2 " " 18·75°. (Abl.)

100 pts. H_2O at t° dissolve pts. $NaNO_3$.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
−6	68·80	50	111·13
0	79·75	60	119·94
10	84·30	70	129·63
16	87·63	80	140·72
20	89·55	90	153·63
30	95·37	100	168·20
40	102·31	120	225·30

(Poggiale, A. ch. (3) **8.** 469.)

100 pts. H_2O at 119° dissolve 150 pts. $NaNO_3$. (Griffiths.)

$NaNO_3$+Aq sat. at 18·75° has 1·3769 sp. gr., and 100 pts. H_2O have dissolved 88·001 pts. $NaNO_3$. (Karsten.)

$NaNO_3$+Aq sat. in cold contains 33·3 % $NaNO_3$. (Fourcroy.)

$NaNO_3$+Aq sat. at 12·5° contains 34 % $NaNO_3$. (Hassenfratz.)

100 pts. H_2O at 15·5° dissolve 33 pts.; at 52°, 100 pts. $NaNO_3$. (Ure's Dict.)

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	73·0	60·65	125·5
13·9	81·6	99·9	173·6
44·65	110·5	119·7	211·4

(Nordenskjöld, Pogg. **136.** 312.)

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	70·94	70	142·31
10	78·57	80	153·72
20	87·97	90	165·55
30	98·26	100	178·18
40	109·01	110	194·26
50	120·00	119·4	213·43
60	131·11	...	...

(Maumené, C. R. **58.** 81.)

100 pts. $NaNO_3$ + Aq sat. at 14° contain 43·88 pts. $NaNO_3$; at 15°, 44·53 pts. $NaNO_3$. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O dissolve 84·21-84·69 pts. $NaNO_3$ at 15·6°, and sat. solution has sp. gr. 1·337-1·378. (Page and Keightley, Chem. Soc. (2) **10.** 556).

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	66·69	18	83·62
2	70·97	21	85·73
4	71·04	26	90·33
8	75·65	29	92·93
10	76·31	36	99·39
13	79·00	51	113·63
15	80·60	68	125·07

Solubility is constant from 0° to −15·7°, when $NaNO_3 + 7H_2O$ separates out. (Ditte, C. R. **80.** 1164.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	72·9	60	122
1	74·7	61	124
2	75·4	62	125
3	76·0	63	126
4	76·7	64	127
5	77·4	65	128
6	78·1	66	130
7	78·7	67	131
8	79·4	68	132
9	80·1	69	133
10	80·8	70	134
11	81·4	71	136
12	82·0	72	137
13	82·7	73	138
14	83·4	74	139
15	84·0	75	140
16	84·7	76	142
17	85·4	77	143
18	86·1	78	145
19	86·8	79	146
20	87·5	80	148
21	88·3	81	149
22	89·0	82	151
23	89·7	83	152
24	90·3	84	153
25	91·0	85	155
26	91·8	86	156
27	92·5	87	158
28	93·2	88	159
29	94·0	89	161
30	94·9	90	162
31	96·0	91	164
32	96	92	166
33	97	93	168
34	98	94	169
35	99	95	171
36	100	96	173
37	100	97	175
38	101	98	177
39	102	99	178
40	102	100	180
41	103	101	182
42	104	102	184
43	105	103	186
44	106	104	188
45	107	105	190
46	108	106	192
47	109	107	194
48	110	108	196
49	111	109	198
50	112	110	200
51	113	111	202
52	114	112	204
53	115	113	207
54	116	114	209
55	117	115	211
56	118	116	213
57	119	117	215
58	120	117·5	216·4
59	121	...	...

(Mulder, Scheik. Verhandel. **1864.** 83.)

Sat. solution at b.-pt. contains 216·4 pts. $NaNO_3$ (Mulder); 218·5 pts. $NaNO_3$ (Marx); 213·4 pts. $NaNO_3$ (Maumené); 211·4 pts. $NaNO_3$ (Nordenskjöld); 224·8 pts. $NaNO_3$ (Legrand); 150 pts. $NaNO_3$ (Griffiths).

Sp. gr. of $NaNO_3$+Aq at 19·5°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
12·057	1·0844	39·860	1·3176
22·726	1·1667	46·251	1·3805
31·987	1·2450	...	...

(Kremers, Pogg. **95.** 120.)

Sp. gr. of $NaNO_3$+Aq at 20·2°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
1	1·0065	26	1·1904
2	1·0131	27	1·1987
3	1·0197	28	1·2070
4	1·0264	29	1·2154
5	1·0332	30	1·2239
6	1·0399	31	1·2325
7	1·0468	32	1·2412
8	1·0537	33	1·2500
9	1·0606	34	1·2589
10	1·0676	35	1·2679
11	1·0746	36	1·2770
12	1·0817	37	1·2863
13	1·0889	38	1·2958
14	1·0962	39	1·3055
15	1·1035	40	1·3155
16	1·1109	41	1·3225
17	1·1184	42	1·3355
18	1·1260	43	1·3456
19	1·1338	44	1·3557
20	1·1418	45	1·3659
21	1·1498	46	1·3761
22	1·1578	47	1·3864
23	1·1659	48	1·3968
24	1·1740	49	1·4074
25	1·1822	50	1·4180

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Sp. gr. of $NaNO_3$+Aq at 18°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
5	1·0327	20	1·1435
10	1·0681	30	1·2278

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $NaNO_3$+Aq at 20°, containing mols. $NaNO_3$ in 100 mols. H_2O.

Mols. $NaNO_3$	Sp. gr.
2	1·05980
5	1·13813

(Nicol, Phil. Mag. (5) **16.** 122.)

The saturated solution boils at 117·5°. (Mulder.)
,, ,, ,, 118·9°. (Griffiths.)
,, ,, ,, 119°. (Marx.)
,, ,, ,, 119·4°. (Maumené.)
,, ,, ,, 119·7°. (Nordenskjöld.)
,, ,, ,, 121°. (Legrand.)
,, ,, ,, 122-123°. (Kremers.)

Forms a crust at 118°, and contains 194 pts. $NaNO_3$ to 100 pts. H_2O; highest temp. observed, 120·5°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $NaNO_3$+Aq containing pts. $NaNO_3$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 443); L=according to Legrand (A. ch. (2) **59.** 431).

B-.pt.	G	L	B.-pt.	G	L
101°	9	9·3	112°	121·5	120·3
102	18·5	18·7	113	133	131·3
103	28	28·2	114	144·5	142·4
104	38	37·9	115	156	153·7
105	48	47·7	116	168·5	165·2
106	58	57·6	117	181	176·8
107	68	67·7	118	194	188·6
108	78·5	77·9	119	207·5	200·5
109	89	88·3	120	222	212·6
110	99·5	98·8	121	...	224·8
111	110·5	109·5	...	...	...

50 pts. $NaNO_3$ mixed with 100 pts. snow at −1° give a temp. of −17·5°. (Rüdorff, Pogg. **122.** 337.)

Sol. in 66 pts. HNO_3; in 32 pts. $2HNO_3, 3H_2O$ at 32°; in 4 pts. $2HNO_3, 3H_2O$ at 123°. (Schultz, Zeit. Ch. (2) **5.** 531.)

Solubility in NaOH+Aq at 0°. $NaNO_3$=mols. $NaNO_3$ (in mg.) in 10 ccm. of solution; Na_2O=mols. Na_2O (in mg.) in 10 ccm. of solution.

$NaNO_3$	Na_2O	$NaNO_3$ $+Na_2O$	Sp. gr.
66·4	0	66·4	1·341
62·5	2·875	65·375	1·338
57·15	6·1	63·25	1·333
47·5	12·75	60·25	1·327
29·5	26	55·5	1·326
17·5	39	56·5	1·332
13·19	45·875	59·065	1·356
6·05	60·875	66·925	1·401

(Engel, Bull. Soc. (3) **6.** 16.)

Sol. in sat. KNO_3+Aq; solution thus made at 18° contains 54·33 % mixed salt, or 100 pts. H_2O dissolve 118·98 pts. mixed salt, viz. 89·53 pts. $NaNO_3$ and 29·45 pts. KNO_3. (See KNO_3.)

Sol. in sat. NH_4NO_3+Aq. (See NH_4NO_3.)

Sol. in sat. $Ba(NO_3)_2$+Aq, with partial pptn. of $Ba(NO_3)_2$. (See $Ba(NO_3)_2$.)

Sol. in sat. $Pb(NO_3)_2$+Aq, with subsequent pptn. of $Pb(NO_3)_2$.

Sol. in sat. KCl+Aq, with formation of KNO_3.

Sol. in sat. NH_4Cl+Aq.

Very rapidly sol. in sat. $BaCl_2$+Aq with pptn. of $Ba(NO_3)_2$.

Easily sol. in K_2SO_4+Aq without pptn.

Easily sol. in Na_2SO_4+Aq without pptn.

Sol. in $MgSO_4$+Aq, at first to a clear solution, but afterwards $NaNO_3$ is pptd.

Very sol. in sat. $CuSO_4$+Aq, but double sulphate separates out.

Very sol. in $ZnSO_4$+Aq with pptn. of double sulphate. (Karsten.)

$NaNO_3+Sr(NO_3)_2$.

If $Sr(NO_3)_2$+Aq sat. at 14·5° is sat. with $NaNO_3$, 100 pts. H_2O dissolve:

$NaNO_3$.	83·7	66·4	...
$Sr(NO_3)_2$.	...	51·0	62·0
		117·4	

(Mulder.)

NaCl+$NaNO_3$.

100 pts. H_2O dissolve 24·91 pts. NaCl+54·55 pts. $NaNO_3$=79·46 pts. of the two salts at 20°. (Nicol, Phil. Mag. (5) **31.** 386.)

100 pts. H_2O dissolve at 18·75°:

	1	2	3	4	5	6
NaCl .	36	25·22	24·96	24·98	...	24·6
$NaNO_3$	...	52·89	52·84	52·82	86·6	56·8

2. Sat. NaCl+Aq treated with $NaNO_3$.
3. Sat. $NaNO_3$+Aq treated with NaCl.
4. Simultaneous treatment of the two salts by H_2O. (Karsten.)
6. Excess of both salts + Aq warmed and cooled to 20°. (Rüdorff, B. **6.** 484.)

Solubility of NaCl with addition of $NaNO_3$ at 15·5°.

Sp. gr.	100 ccm. contain in g.		
	NaCl	H_2O	$NaNO_3$
1·2025	31·78	88·47	0·00
1·2305	27·89	87·63	7·53
1·2580	26·31	86·25	13·24
1·2810	23·98	82·66	21·58
1·3090	22·30	80·42	28·18
1·3345	20·40	79·25	33·80
1·3465	19·40	77·37	37·88
1·3465	19·67	77·34	37·64

$NaNO_3$ separated in last two solutions.

Solubility of $NaNO_3$ with addition of NaCl at 15°.

Sp. gr.	100 ccm. contain in g.		
	$NaNO_3$	H_2O	NaCl
1·3720	62·38	74·82	0
1·3645	56·56	75·69	4·00
1·3585	52·09	75·71	7·24
1·3530	47·08	76·86	11·36
1·3495	42·66	76·96	15·33
1·3485	39·90	77·14	17·81
1·3485	38·73	77·15	18·97
1·3485	38·02	77·49	19·34

NaCl separated in last two solutions.

(Bodländer, Z. phys. Ch. **7.** 360.)

100 pts. alcohol of 0·9 sp. gr. dissolve 10·5 pts. $NaNO_3$; 0·872 sp. gr., 6 pts.; 0·834 sp. gr., 0·38 pt.; insol. in alcohol of 0·817 sp. gr. (Kirwan.)

100 pts. alcohol of 61·4 % by weight dissolve 21·2 pts. $NaNO_3$ at 26°. (Pohl, W. A. B. **6.** 600.)

100 pts. alcohol of 62° Tr. dissolve 7·4 pts. $NaNO_3$ at 19·5°.

100 pts. alcohol of 93° Tr. dissolve 0·93 pt. $NaNO_3$ at 19·5°. (Wittstein.)

100 pts. alcohol containing % alcohol by weight dissolve pts. $NaNO_3$ at 15°, or 100 pts. solution contain % $NaNO_3$:

10	20	30	40	60	80	% alcohol.
65·3	48·8	35·5	25·8	11·4	2·8	pts. $NaNO_3$.
39·5	32·8	26·2	20·5	10·2	2·7	% $NaNO_3$.

(Schiff.)

100 pts. wood-spirit of 40 % dissolve 32·3 pts. $NaNO_3$. (Schiff, A. **118.** 365.)

Solubility in alcohol at 16·5°.

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	$NaNO_3$
1·3745	0	75·25	62·20
1·3162	6·16	70·82	54·64
1·2576	11·60	68·10	46·06
1·2140	16·49	65·04	39·87
1·1615	22·17	61·67	32·31
1·0855	32·22	52·92	23·41
1·0558	37·23	48·50	19·85
1·0050	43·98	42·78	13·74
0·9420	52·60	32·13	9·47
0·9030	60·00	25·65	4·65
0·8610	63·16	21·31	1·63

(Bodländer, Z. phys. Ch. **7.** 317.)

100 pts. absolute methyl alcohol dissolve 0·41 pt. at 25°.

100 pts. absolute ethyl alcohol dissolve 0·036 pt. at 25°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sol. in glycerine.

Sodium nitrate sulphate, $NaNO_3$, $Na_2SO_4 + \frac{1}{2}H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **12.** 44.)

Strontium nitrate, $Sr(NO_3)_2$.

Sol. in 5 pts. cold, and 0·5 pt. boiling H_2O. (Dumas.)
" 2 " " 0·5 " " (Wittstein.)
" 5 " at 18-20°. (Abl.)

100 pts. sat. $Sr(NO_3)_2$+Aq at 18-20° contain 45·40 pts. $Sr(NO_3)_2$. (v. Hauer, J. pr. **98.** 137.)

1 pt. $Sr(NO_3)_2$ dissolves in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
0	2·52	25	1·29	75	0·99
10	1·79	50	1·02	100	0·94

(Kremers, Pogg. **92.** 499.)

100 pts. H_2O dissolve at 0°, 39·5 pts. $Sr(NO_3)_2$ (Mulder); at 0°, 40·16 pts. $Sr(NO_3)_2$ (Poggiale); at 0°, 40·1 pts. $Sr(NO_3)_2$ (Kremers); at 100°, 101·1 pts. $Sr(NO_3)_2$ (Mulder); at 100°, 106·5 pts. $Sr(NO_3)_2$ (Kremers, Pogg. **92.** 499); at 100°, 119·25 pts. $Sr(NO_3)_2$ (Poggiale).

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Sr(NO_3)_2$	t°	Pts. $Sr(NO_3)_2$	t°	Pts. $Sr(NO_3)_2$
0	39·5	36	90·7	73	96·0
1	41·2	37	90·8	74	96·2
2	42·8	38	91·0	75	96·4
3	44·3	39	91·1	76	96·5
4	45·8	40	91·3	77	96·7
5	47·3	41	91·4	78	96·8
6	48·8	42	91·5	79	97·0
7	50·3	43	91·6	80	97·2
8	51·8	44	91·8	81	97·4
9	53·4	45	91·9	82	97·5
10	54·9	46	92·1	83	97·7
11	56·5	47	92·2	84	97·9
12	58·0	48	92·3	85	98·0
13	59·6	49	92·5	86	98·2
14	61·2	50	92·6	87	98·4
15	62·8	51	92·8	88	98·6
16	64·4	52	92·9	89	98·8
17	66·0	53	93·1	90	99·0
18	67·6	54	93·2	91	99·2
19	69·2	55	93·4	92	99·4
20	70·8	56	93·5	93	99·6
21	72·5	57	93·6	94	99·8
22	74·1	58	93·8	95	100·0
23	75·8	59	93·9	96	100·2
24	77·4	60	94·0	97	100·4
25	79·0	61	94·2	98	100·6
26	80·7	62	94·3	99	100·9
27	82·4	63	94·5	100	101·1
28	84·1	64	94·6	101	101·3
29	85·8	65	94·8	102	101·6
30	87·6	66	94·9	103	101·8
31	89·5	67	95·1	104	102·0
31·3	90·0	68	95·2	105	102·3
32	90·2	69	95·4	106	102·5
33	90·3	70	95·6	107	102·7
34	90·5	71	95·7	107·9	102·9
35	90·6	72	95·9	...	...

(Mulder, Scheik. Verhandel. **1864.** 114.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 19·5°.

% $Sr(NO_3)_2$	Sp. gr.	% $Sr(NO_3)_2$	Sp. gr.
1	1·009	21	1·192
2	1·017	22	1·202
3	1·025	23	1·213
4	1·034	24	1·223
5	1·041	25	1·233
6	1·049	26	1·246
7	1·059	27	1·257
8	1·068	28	1·268
9	1·076	29	1·280
10	1·085	30	1·292
11	1·095	31	1·304
12	1·103	32	1·316
13	1·113	33	1·329
14	1·122	34	1·340
15	1·131	35	1·354
16	1·140	36	1·367
17	1·150	37	1·381
18	1·160	38	1·395
19	1·170	39	1·410
20	1·181	40	1·422

(Kremers, calculated by Gerlach, Z. anal. **8.** 286.)

Sp. gr. of $Sr(NO_3)_2+Aq$ at 23·4°. a=no. of grms. × ½ mol. wt. dissolved in 1000 grms. H_2O; b=sp. gr. if a is $Sr(NO_3)_2, 4H_2O$, ½ mol. wt. =142; c=sp. gr. if a is $Sr(NO_3)_2$, ½ mol. wt. =106.

a	b	c	a	b	c
1	1·078	1·081	5	1·303	1·350
2	1·146	1·155	6	1·345	1·407
3	1·205	1·224	7	1·383	...
4	1·257	1·284	...	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $Sr(NO_3)_2+Aq$ at 17·5°.

% $Sr(NO_3)_2$	Sp. gr.	% $Sr(NO_3)_2$	Sp. gr.
10	1·083	40	1·422
20	1·180	Sat. sol.	1·52
30	1·294	...	...

(Gerlach, Z. anal. **27.** 283.)

B.-pt. of $Sr(NO_3)_2+Aq$, containing pts. $Sr(NO_3)_2$ to 100 pts. H_2O.

B.-pt.	Pts. $Sr(NO_3)_2$	B.-pt.	Pts. $Sr(NO_3)_2$
100·5°	12	104°	81·4
101	24	104·5	89·6
101·5	34·8	105	97·6
102	45	105·5	105
102·5	54·4	106	112·2
103	63·6	106·3	116·5
103·5	72·6	...	...

(Gerlach, Z. anal. **26.** 448.)

Sat. $Sr(NO_3)_2+Aq$ boils at 106·8°, and contains 112·9 pts. salt to 100 pts. H_2O. (Griffiths.)

Sat. $Sr(NO_3)_2+Aq$ boils at 107·5-108° (Kremers); 107·9° (Mulder).

Sat. $Sr(NO_3)_2+Aq$ forms a crust at 106·3°, and contains 116·5 pts. $Sr(NO_3)_2$ to 100 pts. H_2O; highest temp. observed was 107°. (Gerlach, Z. anal. **26.** 427.)

Very sl. sol. in conc. HNO_3 or $HCl+Aq$. (Wurtz.)

Insol. in HNO_3+Aq. (Schultz, Zeit. Ch. (2) **5.** 537.)

Sol. in 8500 pts. absolute alcohol. Sol. in 60,000 pts. of a mixture of 1 pt. ether and 1 pt. alcohol. (Rose, Pogg. **110.** 296.)

Not completely insol. in boiling amyl alcohol, 30 ccm. dissolving about 1 mg. (Browning, Sill. Am. J. **143.** 52.)

Perfectly anhydrous $Sr(NO_3)_2$ is sol. in 83044 pts. absolute ether-alcohol (1 : 1). (Fresenius, Z. anal. **32.** 190.)

$+4H_2O$. Efflorescent.

Tellurium nitrate, $4TeO_2, N_2O_5+1\frac{1}{2}H_2O$.

Very hygroscopic. Easily decomp. by H_2O. Sol. in HNO_3+Aq, but more sol. when dil. than conc. (Klein and Morel, Bull. Soc. (2) **43.** 205.)

Terbium nitrate (?).

Sl. deliquescent.

Thallous nitrate, $TlNO_3$.

1 pt. $TlNO_3$ dissolves, according to C = Crookes; L = Lamy:

at 15°	18°	58°	107°
in 9·4	10·3	2·3	0·17 pts. H_2O.
C	L	L	L

Insol. in alcohol. (Lamy.)

Thallous nitrate, acid, $TlNO_3, 3HNO_3$.

(Ditte.)

Thallic nitrate, $Tl(NO_3)_3+6H_2O$, or $8H_2O$.

Deliquescent. Sol. in H_2O.

Thorium nitrate, $Th(NO_3)_4+12H_2O$.

Very deliquescent, and sol. in H_2O and alcohol.

Tin (Stannous) nitrate, basic, $2SnO, N_2O_5$.

Difficultly sol. with partial decomp. in H_2O. (Weber, J. pr. (2) **26.** 121.)

Stannous nitrate, $Sn(NO_3)_2+20H_2O$.

Deliquescent, and easily decomp. (Weber, J. pr. (2) **26.** 121.)

Stannic nitrate, $Sn(NO_3)_4$.

Sol. in H_2O, but decomp. very soon on standing. Stable in presence of conc. HNO_3+Aq at 90°, but decomp. at 100°. (Montemartini, Gazz. ch. it. **22.** 384.)

Titanium nitrate, $5TiO_2, N_2O_5+6H_2O$.

Sol. to a slight milkiness in cold H_2O. Decomp. on boiling. (Merz, J. pr. **99.** 157.)

Uranyl nitrate, basic.

Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 209.)

Uranyl nitrate, $UO_2(NO_3)_2$.

$+3H_2O$. Cryst. out of hot HNO_3+Aq. (Ditte.)

$+6H_2O$. Deliquescent in moist, and efflorescent in dry air. Sol. in 0·5 pt. cold H_2O, in 0·3 pt. absolute alcohol, and in 4·0 pts. ether. (Bucholz.)

Melts in crystal H_2O at 59·4°. (Ordway.)

Uranyl nitrate phosphate, $UO_2H_4(PO_4)_2, UO_2(NO_3)_2+14H_2O$.

Easily sol. in warm H_2O, with gradual decomp. Easily sol. in HNO_3, HCl, or H_2SO_4+Aq. Sol. in acetic acid with decomp. (Heintz, A. **151.** 216.)

***Di*vanadyl nitrate** (?).

Known only in solution. Decomp. on evaporation.

Ytterbium nitrate, basic.

Easily sol. in H_2O.

Ytterbium nitrate (?).

Very sol. in H_2O.

Yttrium nitrate, basic, $2Y_2O_3, 3N_2O_5+9H_2O$.

Deliquescent in moist air. Decomp. by cold or boiling H_2O. Sol. in a solution of yttrium nitrate without decomp. (Bahr and Bunsen, A. **137.** 1.)

Yttrium nitrate, $Y(NO_3)_3+6H_2O$.

Easily sol. in H_2O, alcohol, or ether. (Cleve.)

Zinc nitrate, basic, $8ZnO, N_2O_5+2H_2O$.

Insol. in H_2O. (Grouvelle, A. ch. **19.** 137.)

$6ZnO, N_2O_5+8H_2O=Zn(NO_3)_2, 5Zn(OH)_2+3H_2O$. (Bertels, J. B. **1874.** 274.)

$5ZnO, N_2O_5+5\frac{1}{2}H_2O$. Insol. in cold, somewhat sol. in hot H_2O. (Habermann.)

$+6H_2O$. Slowly decomp. by cold H_2O. (Rousseau and Tite.)

$9ZnO, 2N_2O_5$. Decomp. by H_2O. (Vogel and Reischauer, N. Jahrb. Pharm. **11.** 137.)

$4ZnO, N_2O_5+2H_2O$. (Schindler.)

$+3H_2O$. (Ordway, Sill. Am. J. (2) **32.** 14; Gerhardt, J. Pharm. (3) **12.** 61.)

$2ZnO, N_2O_5+3H_2O$. Decomp. by H_2O, and slowly by alcohol. (Wells, Am. Ch. J. **9.** 304.)

$7ZnO, 4N_2O_5+14H_2O=4Zn(NO_3)_2, 3Zn(OH)_2+11H_2O$. (Bertels.)

Zinc nitrate, $Zn(NO_3)_2+6H_2O$.

Very deliquescent. Easily sol. in H_2O or alcohol.

Sp. gr. of $Zn(NO_3)_2$+Aq. F.=according to Franz (J. pr. (2) **5.** 274) at 17·5°; O.=according to Oudemans (Z. anal. **7.** 410) at 14°:

	5	10	15	20	25 % $Zn(NO_3)_2$,
F.	1·0496	1·0968	1·1476	1·2024	1·2640
O.	1·0425	1·087	1·1355	1·1875	1·245

	30	35	40	45	50 % $Zn(NO_3)_2$.
F.	1·3268	1·3906	1·4572	1·5258	1·5984
O.	1·305	...	...	...	...

Calculated for $Zn(NO_3)_2+6H_2O$:

10	20	30	40	50 % salt.
1·05361	1·1131	1·1782	1·2496	1·3292

(Oudemans.)

Melts in its crystal H_2O at 36·4° (Ordway), 50° (Pierre); boils at 131° (Ordway).

$Zn(NO_3)_2$+Aq when heated soon decomposes, with formation of an insol. basic salt. (Ordway.)

Zinc nitrate ammonia, $Zn(NO_3)_2, 4NH_3+\frac{2}{3}H_2O$.

Deliquescent. Sol. in H_2O. (André, C. R. **100.** 639.)

$13ZnO, 3N_2O_5, 4NH_3+18H_2O$.

Zirconium nitrate, basic, $3ZrO_2, 2N_2O_5$.

Insol. in H_2O.

ZrO_2, N_2O_5. Easily sol. in H_2O and alcohol.

$+H_2O$. As above.

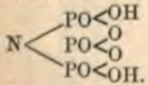
Zirconium nitrate, $Zr(NO_3)_4+5H_2O$ (?).

Deliquescent, and sol. in H_2O.

Nitric oxide, NO.

See **Nitrogen *di*oxide.**

Nitrilo*trimeta*phosphoric acid, $H_2NP_3O_7$ =



$$N\begin{cases}PO<^{OH}_{O}\\ PO<^{O}_{O}\\ PO<_{OH}\end{cases}$$

Known only in solution. (Mente, A. **248.** 260.)

Aluminum nitrilo*trimeta*phosphate.

Insol. in H_2O, conc. HCl, or HNO_3+Aq. Slowly sol. in boiling conc. H_2SO_4. Sol. in warm NaOH+Aq or Na_2CO_3+Aq without decomp. Insol. in NH_4OH+Aq. (Mente.)

Barium ——, $BaNP_3O_7$.

Insol. in dil. or conc. acids. Decomp. by boiling NaOH or Na_2CO_3+Aq. Insol. in NH_4OH+Aq. (Mente.)

Cadmium ——.

Easily sol. in NH_4OH+Aq, or boiling $(NH_4)_2CO_3$, or NaOH+Aq. (Mente.)

Calcium ——, $CaNP_3O_7+H_2O$.

Sol. in conc. HCl+Aq by long boiling, and more easily in fuming HNO_3+Aq. Insol. in NH_4OH or NaOH+Aq. (Mente.)

Chromium ——.

Slowly sol. in dil. acids. Easily sol. in ammonia. Sol. in cold NaOH+Aq. (Mente.)

Cobalt ——, $CoNP_3O_7+H_2O$.

Insol. in H_2O. Sl. sol. in dil. acids. Easily sol. in NH_4OH+Aq. Decomp. by NaOH or Na_2CO_3+Aq. (Mente.)

Copper ——.

Sol. in NH_4OH+Aq. Decomp. by NaOH+Aq. (Mente.)

Ferric ——, $Fe_2(NP_3O_7)_3$.

Insol. in conc. acids. Easily sol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq. Decomp. by NaOH or Na_2CO_3+Aq. (Mente.)

Lead ——.

Insol. in dil. acids. Sol. in fuming HNO_3. Insol. in NH_4OH+Aq. Sol. in NaOH+Aq. (Mente.)

Magnesium ——, $MgNP_3O_7+H_2O$.

Slowly sol. in HCl+Aq. Sol. in H_2SO_4 or fuming HNO_3 with addition of Br_2. Insol. in NH_4OH or $(NH_4)_2CO_3$+Aq. (Mente.)

Manganous ——, $MnNP_3O_7+H_2O$.

Insol. in dil. acids. Very sl. sol. in NaOH+Aq. Insol. in Na_2CO_3 or $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4OH+Aq. (Mente.)

Mercurous ——, $Hg_2NP_3O_7$.

Insol. in dil. acids, NH_4OH, NaOH, or $(NH_4)_2CO_3$+Aq. Easily sol. in fuming HNO_3. (Mente.)

Nickel ——, $NiNP_3O_7+H_2O$.

Insol. in dil. acids, NH_4OH, or $(NH_4)_2CO_3$+Aq. (Mente.)

Zinc ——.

Easily sol. in NH_4OH, NaOH, or $(NH_4)_2CO_3$+Aq. (Mente.)

Nitrilosulphonic acid, $N(SO_3H)_3$.

Not known in free state. (Raschig, A. **241.** 161.)

Potassium nitrilosulphonate, $N(SO_3K)_3+2H_2O$.

Soluble in H_2O. (Raschig, A. **241.** 161.)

Is identical with "potassium ammon*tri*sulphonate" of Claus.

Insol. in cold H_2O (Claus); sol. in 50 pts. H_2O at 23° (Fremy); in H_2O at scarcely 40° without change. Decomp. by boiling. (Claus.)

Potassium sodium nitrilosulphonate, $N(SO_3K)_2(SO_3Na)$.

Nearly insol. in cold H_2O. (Raschig, A. **241.** 161.)

Sodium nitrilosulphonate, $N(SO_3Na)_3$.

Not isolated on account of its extreme solubility in H_2O. (Raschig, A. **241.** 161.)

Nitritocobaltic chloride.

Sol. in 200 pts. cold H_2O. (Jörgensen, Z. anorg. **5.** 172.)

Nitritoplatin*di*amine nitrate, $(NO_2)_2Pt(N_2H_6NO_3)_2$.

Sol. in cold H_2O with decomp.; violently decomp. on warming. (Hadow, Chem. Soc. (2) **4.** 345.)

Nitritopurpureocobaltic comps.

See **Xanthocobaltic comps.**

Nitritopurpureorhodium comps.

See **Xanthorhodium comps.**

Nitro cobalt, Co_2NO_2.

Decomp. by H_2O. (Sabatier and Senderens, C. R. **115.** 236.)

Nitro copper, $CuNO_2$.

Violently decomp. by H_2O. (Sabatier and Senderens, C. R. **116.** 756.)

Nitroferricyanhydric acid.

See **Nitroprussic acid.**

Nitrogen, N_2.

Nearly insol. in all known solvents.

1 vol. recently boiled H_2O absorbs 0·0147 vol. N at 15·5°. (Henry, **1803.**)

1 vol. recently boiled H_2O absorbs 0·025 vol. N. (Dalton.)

1 vol. recently boiled H_2O absorbs 0·0156 vol. N at ord. temp. (Dalton.)

1 vol. H_2O at t° and 760 mm. absorbs V vols. N gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0·02035	7	0·01713	14	0·01500
1	0·01981	8	0·01675	15	0·01478
2	0·01932	9	0·01640	16	0·01458
3	0·01884	10	0·01607	17	0·01441
4	0·01838	11	0·01577	18	0·01426
5	0·01794	12	0·01549	19	0·01413
6	0·01752	13	0·01523	20	0·01403

(Bunsen.)

Coefficient of absorption = $0{\cdot}020346 - 0{\cdot}00053887t + 0{\cdot}000011156t^2$. (Bunsen.)

1 l. H_2O absorbs ccm. N from atmospheric air at 760 mm. pressure and t°.

t°	ccm. N	t°	ccm. N
0	19·29	15	13·95
5	17·09	20	12·80
10	15·36	25	11·81

(Dittmar, Challenger Exped. Report, vol. i.)

t°	ccm. N	t°	ccm. N
0	19·14	15	13·73
5	16·93	20	12·63
10	15·14	25	11·80

(Hamberg, **1885.**)

Absorption of N by H_2O at t° and 760 mm. β=coefficient of absorption.

t°	β	t°	β	t°	β
0	0·02388	18	0·01696	36	0·01252
1	2337	19	1667	37	1233
2	2288	20	1639	38	1215
3	2241	21	1611	39	1198
4	2196	22	1584	40	1182
5	2153	23	1557	41	1166
6	2111	24	1530	42	1151
7	2070	25	1504	43	1137
8	2031	26	1478	44	1124
9	1993	27	1453	45	1111
10	1956	28	1428	46	1099
11	1920	29	1404	47	1088
12	1885	30	1380	48	1078
13	1851	31	1357	49	1069
14	1818	32	1334	50	1061
15	1786	33	1312	60	1000
16	1755	34	1291	100	1000
17	1725	35	1271	...	...

(Bohr and Bock, W. Ann. **44.** 318.)

Absorption of N by H_2O at t° and 760 mm. β= coefficient of absorption; β_1= "Solubility" (see under Oxygen).

t°	β	β_1
0	0·02348	0·02334
1	2291	2276
2	2236	2220
3	2182	2166
4	2130	2113
5	2081	2063
6	2032	2013
7	1986	1966
8	1941	1920
9	1898	1877
10	1857	1834
11	1819	1795
12	1782	1758
13	1747	1722
14	1714	1687
15	1682	1654
16	1651	1622
17	1622	1591
18	1594	1562
19	1567	1534
20	1542	1507
21	1519	1482
22	1496	1457
23	1473	1433
24	1452	1410
25	1432	1387
26	1411	1365
27	1392	1344

Absorption of N by H_2O, etc.—*Continued.*

t°	β	$β_1$
28	0·01374	0·01323
29	1356	1303
30	1340	1284
31	1321	1263
32	1304	1243
33	1287	1224
34	1270	1204
35	1254	1185
36	1239	1167
37	1224	1149
38	1210	1131
39	1196	1114
40	1183	1097
41	1171	1082
42	1160	1067
43	1149	1052
44	1139	1037
45	1129	1023
46	1120	1009
47	1111	0995
48	1102	0982
49	1094	0968
50	1087	0955
52	1072	0929
54	1058	0902
56	1045	0876
58	1033	0849
60	1022	0822
62	1011	0794
64	1001	0765
66	0992	0736
68	0983	0707
70	0976	0676
72	0970	0645
74	0965	0614
76	0961	0581
78	0959	0546
80	0957	0510
82	0956	0472
84	0955	0432
86	0954	0388
88	0953	0343
90	0952	0294
92	0951	0242
94	0950	0187
96	0949	0128
98	0948	0066
100	0947	0000

(Winkler, B. **24.** 3606.)

1 l. sea water (sp. gr. 1·027) absorbs ccm. N from atmosphere at t° and 760 mm. pressure—

t°	According to Tornoë	According to Dittmar	According to Hamberg
0	14·40	15·60	14·85
5	13·25	13·86	13·32
10	12·10	12·47	12·06
15	10·95	11·34	11·04
20	...	10·41	10·25
25	...	9·62	9·62

At 18° and 760 mm. 100 vols. H_2O or alcohol of 0·84 sp. gr. absorb 4·2 vols. N gas. (de Saussure, **1814.**)

1 vol. alcohol at t° and 760 mm. dissolves V vols. N gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0·12634	13	0·12192
1	0·12593	14	0·12166
2	0·12553	15	0·12142
3	0·12514	16	0·12119
4	0·12476	17	0·12097
5	0·12440	18	0·12076
6	0·12405	19	0·12056
7	0·12371	20	0·12038
8	0·12338	21	0·12021
9	0·12306	22	0·12005
10	0·12276	23	0·11990
11	0·12247	24	0·11976
12	0·12219	...	...

(Bunsen's Gasometry.)

1 vol. alcohol absorbs $0{\cdot}126338 - 0{\cdot}000418t + 0{\cdot}0000060t^2$ vols. N gas. (Carius, A. **94.** 136.)

1 vol. ether absorbs 0·15 vol. N (Döbereiner); 1 vol. caoutchine absorbs 5 vols. N in 5 weeks (Himly).

Coefficient of absorption for petroleum = 0·117 at 20°; 0·135, at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Nitrogen bromide, NBr_3.

Decomp. under H_2O.

Nitrogen bromophosphide, PBr_2N.

Insol. in H_2O. Sol. in ether, less sol. in CS_2 or $CHCl_3$. (Besson, C. R. **114.** 1479.)

Nitrogen chloride, NCl_3.

Very unstable. Explodes when heated to 93° or by contact with other substances. Insol. in H_2O, but is decomp. thereby (in 24 hours by cold H_2O). Sol. in CS_2, PCl_3, and S_2Cl_2. (H. Davy, Phil. Trans. **1813, 1.** 242.)

Nitrogen chlorophosphide, $N_3P_3Cl_6$.

Insol. in H_2O, but slowly decomp. thereby. Insol. in hot H_2SO_4, HCl, or HNO_3+Aq. Decomp. by hot fuming HNO_3. Sol. in alcohol; very sol. in ether, but these solutions gradually decompose. Sol. in CS_2, $CHCl_3$, C_6H_6, and oil of turpentine.

Sol. in $POCl_3$. (Gladstone, Chem. Soc. **3.** 138.)

Nitrogen chlorosulphide.

See **Nitrogen sulphochloride.**

Nitrogen fluoride.

Very explosive. (Warren, C. N. **55.** 289.)

Nitrogen *mono***iodamine,** NH_2I.

Very rapidly decomp. by H_2O into $N_2H_3I_3$. (Raschig, A. **230.** 212.)

Nitrogen *di***iodamine,** NHI_2.

Properties as *tri*iod*di*amine.

Nitrogen *tri***iod***di***amine,** NH_3, NI_3.

Decomp. by H_2O. (Raschig, A. **230.** 212.)

Insol. in absolute alcohol. Sol. with decomp. in HCl+Aq. (Bunsen.)

Nitrogen iodide, NI_3.

Insol. in H_2O, but slowly decomp. thereby. Sol. in HCl+Aq. Sol. in KCN+Aq. (Millon, J. pr. **17.** 1.)

Sol. in $Na_2S_2O_3$+Aq. (Guyard, C. R. **97.** 526.)

Sol. in KSCN + Aq. (Raschig, A. **230.** 212.)

Nitrogen *mon*oxide, N_2O.

(a.) *Liquid.* Miscible with alcohol or ether.
(b.) *Gas.*

1 vol. H_2O absorbs 0·78-0·86 vol. N_2O at ordinary temp. (Henry); 0·80 vol. at ordinary temp. (Dalton); 0·76 vol. at ordinary temp. (de Saussure); 0·708 vol. at 18° (Pleisch); 0·54 vol. (Davy).

1 vol. H_2O at t° and 760 mm. absorbs V vols. N_2O, reduced to 0° and 760 mm.

t°	V	t°	V
0	1·3052	13	0·8304
1	1·2605	14	0·8034
2	1·2172	15	0·7778
3	1·1752	16	0·7535
4	1·1346	17	0·7306
5	1·0954	18	0·7090
6	1·0575	19	0·6888
7	1·0210	20	0·6700
8	0·9858	21	0·6525
9	0·9520	22	0·6364
10	0·9196	23	0·6216
11	0·8885	24	0·6082
12	0·8588	...	...

(Bunsen's Gasometry.)

1 vol. H_2O absorbs $1·30521 - 0·0453620t + 0·00068430t^2$ vols. N_2O at t° and 760 mm. (Bunsen.)

100 vols. KOH + Aq (sp. gr. = 1·12) absorb 18·7 vols. N_2O; 100 vols. KOH + Aq sat. with pyrogallol absorb 18·1 vols. N_2O; 100 vols. NaOH + Aq (sp. gr. = 1·1) (7 % NaOH) absorb 23·1 vols. N_2O; 100 vols. NaOH + Aq sat. with pyrogallol absorb 28·0 vols. N_2O.

100 vols. conc. $FeSO_4$ + Aq absorb 19·5 vols. N_2O.

100 vols. H_2SO_4 (sp. gr. = 1·84) absorb 75·7 vols. N_2O; 100 vols. H_2SO_4 + Aq (sp. gr. = 1·80) absorb 66·0 vols. N_2O; 100 vols. H_2SO_4 + Aq (sp. gr. = 1·705) absorb 39·1 vols. N_2O; 100 vols. H_2SO_4 + Aq (sp. gr. = 1·45) absorb 41·6 vols. N_2O; 100 vols. H_2SO_4 + Aq (sp. gr. = 1·25) absorb 33·0 vols. N_2O. $CaCl_2$ + Aq, and NaCl + Aq absorb considerable amounts of N_2O. (Lunge, B. **14.** 2188.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. N_2O gas reduced to 0° and 760 mm.

t°	V	t°	V
0	4·1780	13	3·3734
1	4·1088	14	3·3200
2	4·0409	15	3·2678
3	3·9741	16	3·2169
4	3·9085	17	3·1672
5	3·8442	18	3·1187
6	3·7811	19	3·0714
7	3·7192	20	3·0253
8	3·6585	21	2·9805
9	3·5990	22	2·9368
10	3·5408	23	2·8944
11	3·4838	24	2·8532
12	3·4279	...	...

(Bunsen's Gasometry.)

Coefficient of absorption = $4·17805 - 0·0698160t + 0·0006090t^2$. (Carius.)

At 18° and 760 mm., 100 vols. H_2O absorb 76 vols. N_2O; 100 vols. alcohol of 0·840 sp. gr. absorb 153 vols.; 100 vols. rectified naphtha of 0·784 sp. gr. absorb 254 vols.; 100 vols. oil of lavender of 0·880 sp. gr. absorb 275 vols.; 100 vols. olive oil of 0·915 sp. gr. absorb 150 vols.; 100 vols. sat. KCl + Aq (26 % KCl) of 1·212 sp. gr. absorb 29 vols. (de Saussure, **1814.**)

1 vol. oil of turpentine absorbs 2·5-2·7 vols. N_2O. (de Saussure.)

Coefficient of absorption for petroleum = 2·11 at 20°; 2·49 at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Nitrogen *di*oxide, NO.

1 vol. H_2O absorbs 0·1 vol. NO gas at ordinary temp. (Davy); 1 vol. absorbs 0·05 vol. (Henry); 1 vol. absorbs $\frac{1}{27}$ vol. (Dalton).

Sol. in conc. HNO_3 + Aq.

100 vols. HNO_3 + Aq of 1·3 sp. gr. agitated with NO gas take up 20 vols. NO. If acid is twice as strong or one half as strong, the quantity NO is proportional to the amount of HNO_3. Very dil. HNO_3 + Aq absorbs scarcely more NO than pure H_2O. (Dalton.)

100 pts. HNO_3+Aq of 1·4 sp. gr. absorb 90 pts. NO (Dalton); sol. in Br_2, and very sl. sol. in conc. H_2SO_4 (Berthelot).

1 ccm. conc. H_2SO_4 of 1·84 sp. gr. absorbs 0·035 ccm. NO; of 1·50 sp. gr., 0·017 ccm. NO. (Lunge, B. **18.** 1391.)

Absorbed by glacial $HC_2H_3O_2$, and by conc. $H_2C_4H_4O_6$ + Aq.

Very sol. in aqueous solutions of ferrous salts, especially the sulphate. (Priestley.)

1 vol. $FeSO_4$ + Aq of 1·081 sp. gr., containing 1 grain $FeSO_4$ to 6 grains H_2O, absorbs 6 vols. NO. (Dalton.)

Also sol. in stannous and chromous salts + Aq. (Peligot.)

Not absorbed by $Fe_2(SO_4)_3$ + Aq. (Dalton.)

Absorption by ferrous salts + Aq is proportional to the amount of Fe present, irrespective of the acid or concentration of the solution. Between 0° and 10°, about 2 mols. NO are absorbed for each atom of Fe; between 10° and 15°, 1 mol. NO for 2 atoms of Fe; and at 25°, only 1 mol. NO for 2½ to 3 atoms of Fe. The amount of NO absorbed also varies with the pressure. The sp. gr. of the ferrous salt solution is greater after the absorption of NO than before. The solutions are decomp. by heat, and at 100° all NO is given off. (Gay, A. ch. (6) **5.** 145.)

1 vol. absolute alcohol absorbs $0·31606 - 0·003487t + 0·000049t^2$ vols. NO between 0° and 25°. (Bunsen.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. NO gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0·31606	7	0·29405
1	0·31262	8	0·29130
2	0·30928	9	0·28865
3	0·30604	10	0·28609
4	0·30290	11	0·28363
5	0·29985	12	0·28127
6	0·29690	13	0·27901

1 vol. alcohol at t°, etc.—*Continued.*

t°	V	t°	V
14	0·27685	20	0·26592
15	0·27478	21	0·26444
16	0·27281	22	0·26306
17	0·27094	23	0·26178
18	0·26917	24	0·26060
19	0·26750	...	...

(Bunsen's Gasometry.)

Abundantly absorbed by CS_2. (Friedburg, C. N. **48**. 97.)

Nitrogen *tri*oxide, N_2O_3.

Sol. in H_2O at 0°. If large amt. of H_2O is present, the solution is quite stable at ordinary temp. (Fremy, C. R. **79**. 61.)

Sol. in HNO_3 + Aq.

Sol. in conc. H_2SO_4 to form $HNOSO_4$.

Sol. in ether.

Nitrogen *tri*oxide stannic chloride, N_2O_3, $SnCl_4$.

Decomp. by H_2O. (Weber, Pogg. **118**. 471.)

Nitrogen *tetr*oxide, NO_2 or N_2O_4.

Sol. in H_2O at 0° with decomp. Miscible with very conc HNO_3. Absorbed abundantly by CS_2, $CHCl_3$, and C_6H_5Cl. (Friedburg, C. N. **47**. 52.)

Sol. in $C_6H_5NO_2$.

Sl. sol. in H_2S + Aq.

Sol. in H_2SO_4 or conc. HNO_3 + Aq.

Nitrogen *pent*oxide, N_2O_5.

Very deliquescent. Combines with H_2O to form HNO_3 with evolution of heat.

Nitrogen *hex*oxide, NO_3.

Decomposes upon air or with H_2O. (Hautefeuille and Chappins, C. R. **92**. 80, 134 ; **94**. 1111, 1306.)

Nitrogen phosphochloride, $P_3N_3Cl_6$.

See **Nitrogen chlorophosphide.**

Nitrogen selenide, N_2Se_2 or N_2Se.

Very explosive. Insol. in H_2O. Sol. in HNO_3 + Aq, and NaClO + Aq. (Espenschied, A. **113**. 101.)

Insol. in H_2O, ether, absolute alcohol ; very sl. sol. in CS_2, C_6H_6, and glacial acetic acid. Decomp. by HCl or KOH + Aq. (Verneuil, Bull. Soc. (2) **38**. 548.)

Nitrogen sulphide, N_2S_2.

Insol. in H_2O. Decomp. by hot H_2O. Sl. sol. in alcohol, ether, wood alcohol, oil of turpentine. Easily sol. in CS_2. Slowly decomp. by HCl + Aq or KOH + Aq, rapidly by HNO_3 + Aq. 15 grammes dissolve in 1 kilo. of CS_2. (Fordos and Gélis, C. R. **31**. 702.)

Sol. in $CHCl_3$. (Demarçay, C. R. **91**. 854.)

Nitrogen sulphochloride, NSCl.

Unstable on air. Sol. in warm $CHCl_3$; crystallises out on cooling. (Demarçay, C. R. **91**. 854, 1066.)

Demarçay calls this comp. thiazyl chloride.

$N_4S_6Cl_2$. Partly sol. in H_2O. (Demarçay, C. R. **92**. 726.)

Demarçay calls this compound *di*thio*tetra*thiazyl *di*chloride.

$N_2S_3Cl_2 = N_2S_2, SCl_2$. Decomp. on air. (Fordos and Gélis.)

Demarçay (C. R. **92**. 726) calls this comp. thio*di*thiazyl *di*chloride.

$N_2S_4Cl_2$. Sol. in H_2O with subsequent decomp. More sol. than S in CS_2. (Soubeiran, A. ch. **67**. 71.)

Is a mixture of S_2Cl_2 and N_2S_2. (Fordos and Gélis, C. R. **31**. 702.)

N_3S_3Cl. Sl. sol. in warm, insol. in cold $CHCl_3$. (Demarçay, C. R. **92**. 726.)

"Thio*tri*azyl chloride." (Demarçay.)

N_3S_4Cl. Sol. in H_2O. Insol. in most solvents. Sl. sol. in $CHCl_3$. Easily sol. in thionyl chloride. (Demarçay, C. R. **91**. 854, 1066.)

Demarçay calls the compound thio*tri*thiazyl chloride $= (NS)_3 \equiv S—Cl$.

$N_4S_5Cl_2 = 2N_2S_2, SCl_2$. Decomp. on air. (Michaelis.)

$N_6S_7Cl_2 = 3N_2S_2, SCl_2$. Not decomp. on air. Decomp. by H_2O containing ammonia.

Nitrogen oxybromide.

See **Nitrosyl** *and* **Nitroxyl bromide.**

Nitrogen oxychloride.

See **Nitrosyl** *and* **Nitroxyl chloride.**

Nitroiodic acid, $I_2O_4(NO)_2$.

See **Nitrosoiodic acid.**

Nitroplatinous acid.

See **Platonitrous acid.**

Nitroprussic acid, $H_2FeC_5N_6O + H_2O = H_2Fe(CN)_5NO + H_2O$.

Deliquescent. Easily sol. in H_2O, alcohol, or ether. (Playfair, A. **74**. 317.)

Nitroprussides.

The alkali and alkali-earth nitroprussides are sol. in H_2O, and the solutions are not pptd. by alcohol. The others are mostly insol. in H_2O.

Ammonium nitroprusside, $(NH_4)_2Fe(CN)_5(NO)$.

Deliquescent. Very sol. in H_2O ; not pptd. therefrom by alcohol. (Playfair.)

Barium nitroprusside, $BaFe(CN)_5NO + 4H_2O$.

Very sol. in H_2O.

$+ 6H_2O$.

Cadmium nitroprusside, $CdFe(CN)_5NO$.

Insol. in H_2O. Sol. in HCl + Aq. Insol. in dil. or conc. HNO_3 + Aq even when boiling. Not attacked by NH_4OH or KOH + Aq. (Norton, Am. Ch. J. **10**. 222.)

Calcium nitroprusside, $CaFe(CN)_5NO + 4H_2O$.

Very sol. in H_2O. (Playfair.)

Cobalt nitroprusside, $CoFe(CN)_5NO$.

Ppt. (Norton, Am. Ch. J. **10**. 222.)

$+ 4H_2O$.

Copper nitroprusside, $CuFe(CN)_5NO + 2H_2O$.

Insol. in H_2O or alcohol.

Ferrous nitroprusside, $FeFe(CN)_5NO + xH_2O$ (?).
Insol. in H_2O.

Mercurous nitroprusside, $Hg_2Fe(CN)_5NO$.
Insol. in H_2O. Unstable. (Norton, Am. Ch. J. **10.** 222.)

Nickel nitroprusside, $NiFe(CN)_5NO$.
As the Co salt. (Norton.)

Potassium nitroprusside, $K_2Fe(CN)_5NO + 2H_2O$.
Sl. deliquescent. Sol. in 1 pt. H_2O at 16°.
$K_2Fe(CN)_5NO, 2KOH$. Very sol. in H_2O.

Silver nitroprusside, $Ag_2Fe(CN)_5NO$.
Insol. in H_2O, alcohol, or HNO_3 + Aq. Sol. in NH_4OH + Aq.

Sodium nitroprusside, $Na_2Fe(CN)_5NO + 2H_2O$.
Sol. in 2½ pts. H_2O at 16°, and in less hot H_2O.

Zinc nitroprusside, $ZnFe(CN)_5NO$.
Very sl. sol. in cold, more in hot H_2O.

Nitrosochloroplatinic acid.

Potassium nitrosochloroplatinate, $K_2PtCl_5(NO)$.
Sol. in H_2O. (Vèzes, C. R. **110.** 757.)

Nitrosochlororuthenic acid.

Ammonium nitrosochlororuthenate, $(NH_4)_2Ru(NO)Cl_5$.
Sol. in H_2O. (Joly, C. R. **107.** 991.)

Potassium nitrosochlororuthenate, $K_2Ru(NO)Cl_5$.
Sol. in H_2O. (Joly.)

Nitrosoiodic acid, $I_2O_4(NO)_2$ (?).

Decomp. with H_2O, alcohol, ether, or acetic ether. Slowly sol. in H_2SO_4. (Kämmerer, J. pr. **83.** 65.)

*Di*nitrososulphuric acid, $H_2N_2SO_5 = H_2SO_3(NO)_2$.

Not known in free state.

Ammonium *di*nitrososulphate, $(NH_4)_2(NO)_2SO_3$.
Sol. in H_2O. Insol. in hot alcohol. (Pelouze, A. **15.** 240.)

Barium ——, $Ba(NO)_2SO_3$.
Sol. in H_2O. (Divers and Haga, Chem. Soc. **47.** 364.)

Lead ——.
Insol. in H_2O. (Divers and Haga, Chem. Soc. **47.** 364.)

Potassium ——, $K_2(NO)_2SO_3$.
Decomp. by H_2O at ordinary temp. Insol. in alcohol. (Pelouze, A. ch. **60.** 160.)

Sodium ——, $Na_2(NO)_2SO_3$.
More sol. than K salt. (Pelouze.)

Nitrosulphide of iron.

See **Ferro*tetra*nitrososulphonic acid.**

***Bi*nitrosulphide of iron.**
Roussin's comp. is ammonium ferro*hepta*nitrososulphonate, which see.

Nitrosulphonic acid, $HNSO_5 = \frac{HO}{NO_2}SO_2$.

(*Lead chamber crystals.*) Rapidly sol. in H_2O with decomp. When brought into large amount of H_2O, no gas is evolved. (Fremy, C. R. **70.** 61.)
Sol. in H_2SO_4 without decomp. Sol. in cold H_2SO_4 + Aq of sp. gr. 1·7-1·55. (Weber, J. pr. **100.** 37.)
Sl. sol. in H_2SO_4 + Aq of 1·6 sp. gr. (Dana.)
More difficultly sol. in dil. than conc. H_2SO_4 + Aq. (Müller.)

Potassium nitrosulphonate, $KOSO_2NO_2$ (?).
Decomp. by H_2O. (Schultz-Sellack, B. **4.** 113.)

Nitrosulphonic anhydride (?), $N_2O_3, 2SO_3 = S_2O_5(NO_2)_2$.
Rapidly sol. in H_2O with decomp. Abundantly sol. in cold H_2SO_4. (Rose, Pogg. **47.** 605.)
Insol. in cold, slowly sol. in warm H_2SO_4. (Prevostaye, A. ch. **73.** 362.)

Nitrosulphonic chloride, $NO_4SCl = NO_2SO_2Cl$ (?).
Decomp. by H_2O. Sol. in fuming H_2SO_4 without decomp. Decomp. by conc. H_2SO_4. (Weber, Pogg. **123.** 333.)

*Di*nitrosulphuric acid.

See ***Di*nitrososulphuric acid.**

Nitrosyl bromide, NOBr.

Decomp. with cold H_2O. (Landolt, A. **116.** 177.)

Nitrosyl *tri*bromide, $NOBr_3$.
Decomp. by H_2O or cold alcohol.
Miscible with ether. (Landolt, A. **116.** 177.)
Mixture of NOBr and Br_2. (Fröhlich, A. **224.** 270.)

Nitrosyl platinic bromide, $2NOBr, PtBr_4$.
Deliquescent. Decomp. by H_2O. (Topsoe, J. B. **1868.** 274.)

Nitrosyl chloride, NOCl.
Decomp. by H_2O. Absorbed by fuming H_2SO_4 without decomp.

Nitrosyl boron chloride, $NOCl, BCl_3$.
See **Boron nitrosyl chloride.**

Nitrosyl platinic chloride, $2NOCl, PtCl_4$.
Very deliquescent, and sol. in H_2O with evolution of NO. (Rogers and Boye, Phil. Mag. J. **17.** 397.)

Nitrosyl thallium chloride, $2NOCl, TlCl, TlCl_3$.
Very deliquescent, and sol. in H_2O with decomp. (Sudborough, Chem. Soc. **59.** 657.)

Nitrosyl stannic chloride, $2NOCl, SnCl_4$.
Decomp. by H_2O, chloroform, or benzene, not by carbon disulphide. (Jörgensen.)

Nitrosyl titanium chloride, $2NOCl, TiCl_4$.
Decomp. by H_2O. (Weber, Pogg. **118.** 476.)

Nitrosyl zinc chloride, $NOCl, ZnCl_2$.
Very deliquescent, and sol. in H_2O with

evolution of NO. (Sudborough, Chem. Soc. **59**. 656.)

Nitrosyl chloride sulphur *tri*oxide, $NOCl, SO_3$.

Decomp. by H_2O. Sol. in conc. H_2SO_4 with evolution of HCl. (Weber, Pogg. **123**. 233.)

Nitrosyl sulphate, acid, $H(NO)SO_4$.

See **Nitrosulphonic acid.**

Nitrosyl sulphate, anhydro, $(NO)_2S_2O_7$.

See **Nitrosulphonic anhydride.**

Nitrosyl sulphuric acid, $H(NO)SO_4$.

See **Nitrosulphonic acid.**

Nitrous acid, HNO_2.

Known only in aqueous solution.
See **Nitrogen *tri*oxide.**

Nitrites.

Normal nitrites, except $AgNO_2$, are sol. in H_2O and alcohol; but, as a rule, they are less sol. than the corresponding nitrates.

Ammonium nitrite, NH_4NO_2.

Very deliquescent, and sol. in H_2O.

H_2O solution decomp. at 50°. (Berzelius.) Very dil. solution can be evaporated on water bath without decomp. (Bohlig, A. **125**. 25.) Solution containing $\frac{1}{1000000}$ pt. NH_4NO_2 can be evaporated to $\frac{1}{2}$ its vol. without decomp. Solution containing $\frac{1}{500}$ pt. gives a distillate containing 8·6 % of NH_4NO_2, while residue contains 82 % of original quantity, 9·4 % being lost. (Schöyen.)

Ammonium cadmium nitrite ammonia, basic, $2NH_4NO_2, Cd(NO_2)_2, Cd(OH)_2, 2NH_3$.

Decomp. by H_2O. (Morin, C. R. **100**. 1497.)

Ammonium cobaltic nitrite, $Co_2O_3, 3(NH_4)_2O, 6N_2O_3 + 3H_2O = Co_2(NO_2)_6, 6NH_4NO_2 + 3H_2O$.

Somewhat sol. in cold H_2O; decomp. by boiling. Decomp. by conc. H_2SO_4, not by acetic or dil. mineral acids. (Erdmann, J. pr. **97**. 405.)

Ammonium rhodium nitrite.

See **Rhodonitrite, ammonium.**

Barium nitrite, $Ba(NO_2)_2 + H_2O$.

Permanent. Very sol. in H_2O. Sol. in 64 pts. 94 % alcohol; nearly insol. in absolute alcohol. (Lang, Pogg. **118**. 285.)

Barium cobaltous potassium nitrite, $Ba(NO_2)_2, Co(NO_2)_2, 2KNO_2$.

Decomp. by H_2O. (Erdmann, J. pr. **97**. 385.)

Barium iridium nitrite.

See **Iridonitrite, barium.**

Barium nickel nitrite, $2Ba(NO_2)_2, Ni(NO_2)_2$.

Somewhat more easily sol. in H_2O than nickel potassium nitrite. (Lang.)

Barium nickel potassium nitrite, $Ba(NO_2)_2, Ni(NO_2)_2, 2KNO_2$.

Sl. sol. in cold, easily in hot H_2O without apparent decomp. (Lang.)

Barium potassium nitrite, $Ba(NO_2)_2, 2KNO_2 + H_2O$.

Easily sol. in H_2O; insol. in alcohol. (Lang, Pogg, **118**. 293.)

Barium rhodium nitrite, $3Ba(NO_2)_2, Rh_2(NO_2)_6$.

See **Rhodonitrite, barium.**

Barium silver nitrite.

Resemble the potassium salt. (Fischer.)

Cadmium nitrite, basic, $2CdO, N_2O_3$.

Insol. in H_2O. (Hampe, A. **125**. 334.)

Cadmium nitrite, $Cd(NO_2)_2 + H_2O$.

Deliquescent. Sol. in H_2O. (Lang, J. B. **1862**. 99.)

Cadmium potassium nitrite, $Cd(NO_2)_2, KNO_2$.

Easily sol. in H_2O. Very difficultly sol. in absolute alcohol, and only sl. sol. in 90 % alcohol. (Hampe, A. **125**. 334.)

$Cd(NO_2)_2, 2KNO_2$. Easily sol. in H_2O. Insol. in alcohol. (Lang, J. B. **1862**. 99.)

$Cd(NO_2)_2, 4KNO_2$. More sol. in H_2O than the above salt. (Lang.)

Cæsium cobaltic nitrite, $Cs_3Co(NO_2)_6 + H_2O$.

Sol. in 20,100 pts. H_2O at 17°. (Rosenbladt, B. **19**. 2531.)

Calcium nitrite, $Ca(NO_2)_2 + H_2O$.

Very deliquescent. Insol. in dil. alcohol. (Fischer, Pogg. **74**. 115.)

Calcium cobaltous potassium nitrite, $Ca(NO_2)_2, Co(NO_2)_2, 2KNO_2$.

Decomp. by H_2O. (Erdmann.)

Calcium nickel potassium nitrite, $Ca(NO_2)_2, Ni(NO_2)_2, 2KNO_2$.

Very sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. Sl. sol. in dil. $HC_2H_3O_2 +$ Aq. (Erdmann.)

Calcium potassium nitrite, $CaK(NO_2)_3 + 3H_2O$.

Sol. in H_2O. (Topsoë, W. A. B. **73, 2**. 112.)
Deliquescent. (Lang.)

Cobaltous nitrite.

Known only in solution.

Cobaltic lead potassium nitrite, $3K_2O, 3PbO, 2Co_2O_3, 10N_2O_3 + 4H_2O$.

Sol. by boiling in much H_2O. Sol. in hot acids with evolution of N_2O_3. (Stromeyer, A. **96**. 228.)

Cobaltous potassium nitrite, $2Co(NO_2)_2, 2KNO_2 + H_2O$.

Ppt. (Sadtler.)

$Co(NO_2)_2, 2KNO_2 + H_2O$. Ppt. (Sadtler.)

$3Co(NO_2)_2, 6KNO_2 + H_2O$. Insol. in cold, sol. in hot H_2O. Sl. sol. in $KC_2H_3O_2 +$ Aq. (Erdmann, J. pr. **97**. 397.)

Cobaltic potassium nitrite (**cobalt yellow**), $Co_2(NO_2)_6, 6KNO_2 + 3H_2O$.

Very sl. sol. in cold H_2O. Insol. in alcohol and ether. Sol. in traces in CS_2. (St. Evre, C. R. **35**. 552.) Insol. in boiling conc. K_2SO_4, KCl, KNO_3, or $KC_2H_3O_2 +$ Aq.

More sol. in NH_4Cl or $NaCl+Aq$ than in H_2O. (Stromeyer.)

Sl. decomp. by $KOH+Aq$, except when very conc.; easily decomp. by $NaOH$ or $Ba(OH)_2+Aq$.

Very sl. sol. in $KC_2H_3O_2+Aq$, or KNO_2+Aq. (Fresenius.) Sol. in $HCl+Aq$.

Sol. in $HC_2H_3O_2$, or $H_2C_2O_4+Aq$. (Stromeyer.)

Small quantity of $HC_2H_3O_2+Aq$ does not dissolve. (Fresenius.)

Cobaltous potassium strontium nitrite, $Co(NO_2)_2$, $2KNO_2$, $Sr(NO_2)_2$.

Decomp. by H_2O. (Erdmann, J. pr. **97.** 385.)

Cobaltic rubidium nitrite, $Rb_3Co(NO_2)_6+H_2O$.

Sol. in 19,800 pts. H_2O. (Rosenbladt, B. **19.** 2531.)

Cobaltic silver nitrite ammonia, Co_2O_3, Ag_2O, $4N_2O_3$, $4NH_3$.

See **Cobalt ammonium comps.**

Cobaltic sodium nitrite, $Co_2(NO_2)_6$, $4NaNO_2+H_2O$.

Ppt. (Sadtler, Sill. Am. J. (2) **49.** 196.)

$Co_2(NO_2)_6$, $6NaNO_2+H_2O$.

Cobaltous thallium nitrite, $Co_2(NO_2)_6$, $6TlNO_2$.

Sol. in 23,810 pts. H_2O at 17°. (Rosenbladt, B. **19.** 2531.)

Cupric nitrite, basic, $2CuO$, N_2O_3.

(Hampe, A. **125.** 345.)

$Cu(NO_2)_2$, $3Cu(OH)_2$. Very sl. sol. in H_2O or alcohol. Easily sol. in dil. acids or ammonia. (van der Meulen, B. **12.** 758.)

Cupric nitrite.

Known only in solution.

Cupric lead potassium nitrite, $CuPbK_2(NO_2)_6$.

(van Lessen, R. t. c. **10.** 13.)

Cupric nitrite ammonia, $Cu(NO_2)_2$, $2NH_3+2H_2O$.

Sol. in little H_2O with absorption of much heat. Decomp. by much H_2O. (Peligot, C. R. **53.** 209.)

$3CuO$, N_2O_3, $2NH_3+H_2O$. As above. (Peligot.)

Iridium hydrogen nitrite, $Ir_2H_6(NO_2)_{12}$.

See **Iridonitrous acid.**

Iridium nitrite *with* **MNO_2.**

See **Iridonitrite, M.**

Lead nitrite, basic, $4PbO$, $N_2O_3+H_2O=Pb(OH)NO_2$, PbO.

Sol. in 143 pts. H_2O at 23°, and 33 pts. at 100°. (Chevreul.)

Sol. in 1250 pts. cold H_2O, and 34·5 pts. at 100°. (Peligot.)

Sol. in cold HNO_3 or $HC_2H_3O_2+Aq$.

Composition is $3PbO$, $N_2O_3+H_2O$. (Meissner, J. B. **1876.** 194.)

Composition is as above. (v. Lorenz, W. A. B. **84, 2.** 1133.)

$3PbO$, $N_2O_3=Pb(NO_2)_2$, $2PbO$. Sol. in H_2O. (Bromeis, A. **72.** 38; v. Lorenz.)

$2PbO$, $N_2O_3+H_2O$. Sl. sol. in H_2O. (Bromeis.)

$+3H_2O$. (Meissner.)

$4PbO$, $3N_2O_3+2H_2O$. Sol. in H_2O. (Meissner, J. B. **1876.** 195.)

Lead nitrite, $Pb(NO_2)_2+H_2O$.

Easily sol. in H_2O. (Peligot, A. ch. **77.** 87.)

Lead nickel potassium nitrite, $Pb(NO_2)_2$, KNO_2, $Ni(NO_2)_2$ (?).

Insol. in H_2O. (Baubigny, A. ch. (6) **17.** 111.)

Lead potassium nitrite, $4Pb(NO_2)_2$, $6KNO_2+3H_2O$.

Easily sol. in H_2O and in absolute alcohol. (Hampe, A. **125.** 334.)

$Pb(NO_2)_2$, $2KNO_2+H_2O$. Easily sol. in H_2O. Insol. in alcohol. (Lang, J. B. **1862.** 102.)

Lead nitrite nitrate.

See **Nitrate nitrite, lead.**

Lithium nitrite, $LiNO_2+\frac{1}{2}H_2O$.

Deliquescent. Easily sol. in alcohol and H_2O.

Magnesium nitrite, $Mg(NO_2)_2+2H_2O$.

Deliquescent, and sol. in H_2O. Solution decomp. by boiling. Easily sol. in absolute alcohol. (Hampe, A. **125.** 334.)

Insol. in absolute alcohol. (Fischer.)

Magnesium potassium nitrite.

Deliquescent, and easily sol. in H_2O. Insol. in alcohol. (Lang.)

Manganous nitrite.

Deliquescent, and sol. in H_2O. (Mitscherlich.) Not obtained in a solid state, as the solution decomp. on evaporation. (Lang, Pogg. **118.** 290.)

Mercuric nitrite, basic, $Hg(NO_2)_2$, $2HgO+H_2O$.

Ppt. (Lang.)

Mercuric potassium nitrite, $Hg(NO_2)_2$, $2KNO_2$.

Easily sol. in H_2O. Insol. in alcohol. (Lang, **1860.**)

Nickel nitrite, basic, $2NiO$, N_2O_3.

Ppt. (Hampe, A. **125.** 343.)

Nickel nitrite, $Ni(NO_2)_2$.

Sol. in H_2O and alcohol. (Lang, J. B. **1862.** 100.)

Nickel potassium nitrite, $Ni(NO_2)_2$, $4KNO_2$.

Moderately sol. in H_2O. (Fischer, Pogg. **74.** 115.) Extremely sol. in H_2O. (Hampe, A. **125.** 346.) Insol. in absolute alcohol.

Nickel potassium strontium nitrite, $Ni(NO_2)_2$, $2KNO_2$, $Sr(NO_2)_2$.

Sl. sol. in cold, easily sol. in hot H_2O.

Nickel nitrite ammonia, $Ni(NO_2)_2$, $4NH_3$.

Sol. in cold H_2O. Decomp. on standing or by heating. Insol. in alcohol. Can be recrystallised by dissolving in NH_4OH+Aq, and adding much absolute alcohol. (Erdmann, J. pr. **97.** 395.)

Palladious nitrite *with* MNO_2.
See **Palladonitrite, M.**

Platinous hydrogen nitrite, $H_2Pt(NO_2)_4$.
See **Platonitrous acid.**

Platinous nitrite *with* MNO_2.
See **Platonitrite, M.**

Potassium nitrite, KNO_2.

Deliquescent. Sol. in H_2O.

Deliquesces in 90 % alcohol; insol. in cold 94 % alcohol. More sol. in H_2O than KNO_3, but less sol. in alcohol. (Fischer.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

$+\frac{1}{2}H_2O$ (?). (Lang, J. pr. **86.** 295.)

Potassium rhodium nitrite, $6KNO_2, Rh_2(NO_2)_6$.
See **Rhodonitrite, potassium.**

Potassium ruthenium nitrite.
See **Ruthenonitrite, potassium.**

Potassium silver nitrite, $KNO_2, AgNO_2+\frac{1}{2}H_2O$.

Completely sol. in a little H_2O, but decomp. by more H_2O. Sol. in KNO_2+Aq without decomp. Insol. in alcohol. (Lang.)

Potassium strontium nitrite, $2KNO_2, Ba(NO_2)_2$.

Sol. in H_2O; insol. in alcohol. (Lang, Pogg. **118.** 293.)

Potassium zinc nitrite, $2KNO_2, Zn(NO_2)_2+H_2O$.

Deliquescent. Easily sol. in H_2O. (Lang, J. B. **1862.** 101.)

Rhodium sodium nitrite, $6NaNO_2, Rh_2(NO_2)_6$.
See **Rhodonitrite, sodium.**

Silver nitrite, $AgNO_2$.

Sol. in 120 pts. cold H_2O (Mitscherlich), in 300 pts. (Fischer), and more abundantly in hot H_2O.

Insol. in alcohol.

Silver sodium nitrite, $AgNO_2, NaNO_2$.

Completely sol. in a little H_2O, but decomp. by more H_2O. (Fischer.)

Silver nitrite ammonia, $AgNO_2, NH_3$.

Sl. sol. in H_2O; less sol. in alcohol; nearly insol. in ether. (Reychler, B. **16.** 2425.)

$AgNO_2, 2NH_3$. (Reychler.)

$AgNO_2, 3NH_3$. Deliquescent. Sol. in H_2O. (Reychler.)

Sodium nitrite, $NaNO_2$.

Not deliquescent. Very sol. in H_2O. Insol. in absolute alcohol.

Sol. in warm 90 % alcohol. (Hampe, A. **125.** 336.)

More sol. in H_2O than $NaNO_3$, but less in alcohol.

100 pts. absolute methyl alcohol dissolve 4·43 pts. at 19·5°; 100 pts. absolute ethyl alcohol dissolve 0·31 pt. at 19·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Strontium nitrite, $Sr(NO_2)_2$.

Very sol. in H_2O, and very sl. sol. in boiling alcohol. (Lang, Pogg. **118.** 287.)

Easily sol. in 90 % alcohol. (Hampe, A. **125.** 340.)

$+H_2O$.

Zinc nitrite, basic, $2ZnO, N_2O_3$.
(Hampe, A. **125.** 334.)

Zinc nitrite, $Zn(NO_2)_2+3H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Lang, J. B. **1862.** 99.)

Nitrous oxide, N_2O.
See **Nitrogen *mon*oxide.**

Nitroxyl bromide, NO_2Br.

Decomp. spontaneously or with H_2O. (Hasenbach, J. pr. (2) **4.** 1.)

Does not exist. (Fröhlich, A. **224.** 270.)

Nitroxyl chloride, NO_2Cl.

Decomp. by H_2O without evolution of gas.

Probably does not exist. (Geuther, A. **245.** 98.)

Nitroxypyrosulphuric acid,
$(HO)S_2O_5(NO_3), H_2O$.

Very deliquescent. Sol. in H_2O with decomp. (Weber, Pogg. **142.** 602.)

Nitryl chloride, NO_2Cl.
See **Nitroxyl chloride.**

Norwegium (?).

Element not been isolated, and existence very doubtful.

Norwegium hydroxide (?).

Sol. in KOH+Aq, or in large excess of $(NH_4)_2CO_3$+Aq or Na_2CO_3+Aq. (Dahl, C. R. **89.** 47.)

Octamine cobaltic compounds.

The formulæ of the following octamine cobaltic compounds should be reduced one half, and they should be classed with the tetramine cobaltic compounds. (Jörgensen, Z. anorg. **2.** 279.)

Octamine cobaltic carbonate, $Co_2(NH_3)_8(CO_3)_6+3H_2O$.

Easily sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2654.)

See **Carbonatotetramine carbonate.**

$Co_2(NH_3)_8O_3(CO_3)_4+3H_2O$. Rather difficultly sol. in H_2O.

—— —— **chloride** (?), $Co_2(NH_3)_8(OH)_2Cl_4+2H_2O$.

Ppt.

$Co_2(NH_3)_8(OH)_2Cl_4, 2HgCl_2$.

$Co_2(NH_3)_8(OH)_2Cl_4, PtCl_4+H_2O$. (Vortmann and Blasberg, B. **22.** 2654.)

—— —— **mercuric chloride,** $Co_2(NH_3)_8Cl_6, 3HgCl_2+H_2O$.

$Co_2(NH_3)_8Cl_6, HgCl_2$. Difficultly sol. in cold H_2O, decomp. on warming. (Vortmann.)

—— —— **chlorosulphite,** $Co_2(NH_3)_8(SO_3)_2Cl_2+4H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2635.)

Octamine cobaltic chromate, $Co_2(NH_3)_8(CrO_4)_3(H_2O)_2+2H_2O$.
Sol. in H_2O or acetic acid.
$+8H_2O$. Sol. in warm H_2O or acetic acid.
$Co_2(NH_3)_8(CrO_4)_2Cr_2O_7(H_2O)_2+H_2O$. Easily sol. in H_2O, from which it is precipitated by dil. HNO_3+Aq. (Vortmann, B. **15.** 5895.)

—— —— **nitrate,** $Co_2(NH_3)_8(NO_3)_6+2H_2O$.
Sol. in H_2O; precipitated by conc. HNO_3+Aq. (Vortmann.)

—— —— **nitratocarbonate,** $Co_2(NH_3)_8(NO_3)_2(CO_3)_2+H_2O$.
Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. **22.** 2650.)
See **Carbonatotetramine cobaltic nitrate.**

—— —— **purpureochloride,** $Co_2(NH_3)_8Cl_6(H_2O)_2$.
Easily sol. in H_2O; partly precipitated from aqueous solution by conc. HCl+Aq. (Vortmann, B. **10.** 1451.)
=Chlorotetramine cobaltic chloride, $ClCo(NH_3)_4(OH_2)Cl_2$, which see. (Jörgensen, J. pr. (2) **42.** 211.)

—— —— **purpureomercuric chloride,** $Co_2(NH_3)_8Cl_6(H_2O)_2$, $6HgCl_2$.
Sl. sol. in cold, easily in hot H_2O. (Vortmann.)
=Chlorotetramine cobaltic mercuric chloride. (Jörgensen, J. pr. (2) **42.** 211.)

—— —— **purpureomercuric hydroxychloride,** $Co_2N_8H_{16}(HgCl)_4(HgOH)_4Cl_6$.
Ppt. (Vortmann and Morgulis, B. **22.** 2647.)
$Co_2N_8H_{16}(HgOH)_8Cl_6$. (V. and M.)
$Co_2N_8H_{16}(HgOH)_8Cl_4(OH)_2$. (V. and M.)

—— —— **purpureomercuriodide, basic,** $Co_2N_8H_{18}(HgOH)_6I_6$.
(Vortmann and Borsbach, B. **23.** 2805.)

—— —— **purpureochloroplatinate.**
Very sl. sol. in H_2O. (Vortmann.)
=Chlorotetramine cobaltic chloroplatinate, $ClCo(NH_3)_4(OH_2)PtCl_6+2H_2O$. (Jörgensen, J. pr. (2) **42.** 215.)

—— —— **roseochloride,** $Co_2(NH_3)_8Cl_6(H_2O)_2+2H_2O$, or $4H_2O$.
Sol. in H_2O. (Vortmann, B. **15.** 1891.)
See **Roseotetramine cobaltic chloride.**

—— —— **roseomercuric chloride,** $Co_2(NH_3)_8Cl_6(H_2O)_2$, $6HgCl_2+3H_2O$.
Ppt. (Vortmann.)

—— —— **roseomercuric hydroxychloride,** $Co_2N_8H_{16}(HgCl)_6(HgOH)_2Cl_6$.
(Vortmann and Morgulis, B. **22.** 2647.)
$Co_2N_8H_{16}(HgOH)_8Cl_6$. (V. and M.)
$Co_2N_8H_{16}(HgOH)_8Cl_4(OH)_2$. (V. and M.)

—— —— **roseomercuriodide,** $Co_2N_8H_{21}(HgI)_3I_6$.
Ppt. Sol. in HCl or HNO_3. (Vortmann and Borsbach, B. **23.** 2806.)
$Co_2N_8H_{20}(HgI)_4I_6$. Ppt. (V. and B.)
$Co_2N_8H_{20}(HgI)_4I_4(OH)_2$. Ppt. (V. and B.)

—— —— **sulphate,** $Co_2(NH_3)_8(OH)_2(SO_4)_2+3H_2O$(?).
Insol. in H_2O or dil. H_2SO_4+Aq. Sol. in moderately conc. HCl+Aq. (Vortmann and Blasberg, B. **22.** 2653.)
$Co_2(NH_3)_8(SO_4)_3+6H_2O$. Sol. in H_2O. (Vortmann.)
$+4H_2O$. Easily sol. in H_2O.
See **Roseotetramine cobaltic sulphate.**

—— —— **sulphatocarbonate,** $Co_2(NH_3)_8SO_4(CO_3)_2+3H_2O$.
Sol. in H_2O. (Vortmann, B. **10.** 1458.)
See **Carbonatotetramine cobaltic sulphate.**
$Co_2(NH_3)_8(SO_4)_2CO_3+4H_2O$. Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2650.)

—— —— **ammonium sulphite,** $Co_2(NH_3)_8(SO_3NH_4)_6+10H_2O$.
See **Octamine cobaltisulphite, ammonium.**

Octamine cobaltisulphurous acid.

Ammonium octamine cobaltisulphite, $Co_2(NH_3)_8(SO_3NH_4)_6+10H_2O$.
Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2632.)
$Co_2(NH_3)_8(SO_3)_2(SO_3NH_4)_2+4H_2O$.

Ammonium barium —— ——, $Co_2(NH_3)_8(SO_3)_6Ba_2(NH_4)_2+7H_2O$.
Ppt. (V. and M.)

Barium —— ——, $Co_2(NH_3)_8(SO_3)_6Ba_3+7H_2O$.
Ppt. (V. and M.)

Cobaltic —— ——, $Co_2(NH_3)_8(SO_3)_6Co_2+36H_2O$, and $24H_2O$.

Luteocobaltic —— ——, $Co_2(NH_3)_8(SO_3)_6(NH_3)_{12}Co_2+8H_2O$.
Ppt. (V. and M.)

Octamine iridium chloride,

$Ir_2(NH_3)_8Cl_6$.
Very sol. in H_2O. (Palmaer, B. **22.** 16.)

Octamine iridium chlorosulphate, $Ir_2(NH_3)_8Cl_4SO_4+4H_2O$.
(Palmaer.)

Osmiamic acid, $H_2N_2Os_2O_6$ or $H_2N_2Os_2O_5$ (?).

Known only in aqueous solution, which is unstable.

Ammonium osmiamate.
Easily sol. in H_2O or alcohol. (Fritzsche and Struve, J. pr. **41.** 97.)

Barium osmiamate, $BaN_2Os_2O_5$.
Moderately sol. in H_2O.

Lead osmiamate.
Ppt. Sol. in acids without decomp.

Lead osmiamate chloride.
Ppt.

Mercurous osmiamate.
Ppt.

Mercuric osmiamate.
Ppt.

Potassium osmiamate, $K_2N_2Os_2O_5$ or $K_2N_2Os_2O_6$.
Sl. sol. in cold, much more easily in hot H_2O. Sl. sol. in alcohol. Insol. in ether.

Silver osmiamate, $Ag_2N_2Os_2O_5$.

Extremely sl. sol. in H_2O or cold HNO_3+Aq. Sol. in NH_4OH+Aq.

Sodium osmiamate.

Easily sol. in H_2O or alcohol.

Zinc osmiamate, $ZnN_2Os_2O_5$.

Decomp. by H_2O. Nearly insol. in NH_4OH+Aq.

Osmic acid, H_2OsO_4.

Stable in H_2O containing alcohol. Sol. in HNO_3 or HCl+Aq. Not attacked by H_2SO_4+Aq. (Moraht and Wischin, Z. anorg. **3.** 153.)

Barium osmate, $BaOsO_4+H_2O$.

Insol. in H_2O. (Claus, Pogg. **65.** 205.)

Calcium osmate, $CaOsO_4$.

Insol. in H_2O. (Fremy, J. pr. **33.** 411.)

Lead osmate.

Insol. in H_2O. (Fremy.)

Potassium osmate, $K_2OsO_4+2H_2O$.

Sl. sol. in cold, much more sol. in hot H_2O, but is decomp. thereby. Sl. sol. in KNO_2+Aq. Insol. in dil. or conc. alcohol and ether. (Fremy, A. ch. (3) **12.** 516.)

Insol. in conc. saline solutions. (Gibbs, Am. J. Sci. (2) **31.** 70.)

Sodium osmate, Na_2OsO_4.

Sol. in H_2O; insol. in alcohol and ether. (Fremy, *l.c.*)

***Per*osmic acid.**

See **Perosmic acid.**

Osmium, Os.

When finely divided and not ignited to a very high temperature, it is sol. in HNO_3+Aq or aqua regia. When ignited it is not attacked by any acid.

Osmium ammonium comps.

See—
Oxyosmiumamine comps., $OsO(NH_3)_2X$.
Oxyosmium*di*amine comps., $OsO_2(NH_3)_4X_2$.

Osmium *di*chloride, $OsCl_2$.

Deliquescent. Sol. in little, but decomp. by more H_2O, with pptn. of Os. Sol. in conc. alkali chlorides+Aq with combination and partial decomp. (Berzelius.)

Sol. in alcohol and ether.

Osmium *tri*chloride, $OsCl_3+3H_2O$.

Sol. in H_2O. (Moraht and Wischin, Z. anorg. **3.** 153.)

Osmium *tetra*chloride, $OsCl_4$.

Sol. in a little H_2O, but decomp. by further addition of that solvent. Sol. in conc. HCl+Aq.

Osmium *tri*chloride *with* MCl.

See **Chlorosmite, M.**

Osmium *tetra*chloride *with* MCl.

See **Chlorosmate, M.**

Osmium *mono*hydroxide, OsO, xH_2O.

Insol. in H_2O. Sl. sol. in KOH+Aq. Slowly but completely sol. in acids. (Berzelius.)

Osmium *di*hydroxide, OsO_2, H_2O.

Sol. in HCl+Aq while still moist. Insol. in H_2SO_4 or HNO_3+Aq.

$+2H_2O$. Sol. in HCl, HNO_3, or H_2SO_4+Aq while still moist. (Claus and Jacoby.)

Osmium *sesqui*hydroxide, $Os_2O_6H_6$.

Sol. in acids, and partly sol. in KOH+Aq. (Claus and Jacoby.)

Osmium iodide, OsI_4.

Extremely deliquescent. Sol. in H_2O of alcohol, but solution is unstable. (Moraht and Wischin, Z. anorg. **3.** 153.)

Osmium *mon*oxide, OsO.

Insol. in H_2O or acids. (Claus and Jacoby.)

Osmium *di*oxide, OsO_2.

Insol. in H_2O or acids.

Osmium *sesqui*oxide, Os_2O_3.

Insol. in acids. (Claus and Jacoby.)

Osmium *tri*oxide, OsO_3, **"Osmic acid."**

Known only in the salts of osmic acid.

Osmium *tetr*oxide, OsO_4, **"Perosmic acid."**

Slowly but abundantly sol. in H_2O. Sol. in alcohol and ether with gradual decomposition. Sol. in NH_4OH+Aq, the solution undergoing decomposition on heating.

Osmium oxide ammonia, OsO_2, $2NH_3+H_2O$.

See **Oxyosmiumamine hydroxide.**

Osmium oxysulphide, $Os_2S_7O_5+2H_2O$.

Unstable.

$OsSO_3+1\frac{1}{2}H_2O$. Insol. in H_2O. (v. Meyer, J. pr. (2) **16.** 77.)

$Os_2O_7S_2+H_2O$. Decomp. and dissolved by HNO_3, HCl, or H_2SO_4+Aq. (Moraht and Wischin, Z. anorg. **3.** 153.)

Osmium sulphide, Os_2S_3 (?).

(Berzelius.)

Min. *Laurite.* Insol. in all acids, even in aqua regia.

Osmium *di*sulphide, OsS_2.

Sl. sol. in H_2O; not more sol. in alkali hydrates or carbonates+Aq. Insol. in alkalies after drying. (Fremy, A. ch. (3) **12.** 521.)

Osmium *tetra*sulphide, OsS_4+xH_2O.

Insol. in alkali sulphides, carbonates, or hydroxides+Aq. Sol. in cold dil. HNO_3+Aq. (Claus.)

Osmocyanhydric acid, $H_4Os(CN)_6$.

Easily sol. in H_2O and alcohol. Insol. in ether. (Martius, A. **117.** 361.)

Barium osmocyanide, $Ba_2Os(CN)_6+6H_2O$.

Easily sol. in H_2O and dil. alcohol. (M.)

Barium potassium osmocyanide, $BaK_2Os(CN)_6+3H_2O$.

Efflorescent. Sl. sol. in cold, easily in hot H_2O.

Ferric osmocyanide, $Fe_4[Os(CN)_6]_3+xH_2O$.

Insol. in H_2O.

Potassium osmocyanide, $K_4Os(CN)_6+3H_2O$.

Moderately sol. in boiling, less in cold H_2O. Insol. in alcohol and ether.

Osmosyl ammonium comps.

See **Oxyosmium amine comps.**

Osmyl *di*tetramine comps.

See **Oxyosmium *di*amine comps.**

Oxamidosulphonic acid.

See **Hydroxylamine *mono*sulphonic acid.**

Oximidosulphonic acid.

See **Hydroxylamine *di*sulphonic acid.**

Oxyamidosulphonic acid.

See **Hydroxylamine sulphonic acid.**

Oxyammonium salts.

See **Hydroxylamine salts.**

Oxycobaltamines, acid comps.

(Maquenne, C. R. **96.** 344.)

Are anhydrooxycobaltamine comps., which see. (Vortmann, M. ch. **6.** 404.)

Oxycobaltamine chloride,

$Co_2(NH_3)_{10}\substack{OH\\O(OH)}Cl_4$.

(Vortmann, M. ch. **6.** 404.)

$Co_2(NH_3)_{10}O_2Cl_4$, $HCl+3H_2O$. Is anhydrooxycobaltamine chloride, which see.

—— **chloronitrate hydrochloride,** $Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_2Cl_2$, $4HCl+3H_2O$.

Is anhydrooxycobaltamine chloronitrate, which see.

—— **chlorosulphate,**

$Co_2(NH_3)_{10}\left(\substack{OH\\O(OH)}\right)(SO_4)Cl_2$, $4HCl$.

Easily decomp.

—— **iodide,** $Co_2(NH_3)_{10}\left(\substack{OH\\O(OH)}\right)I_4$.

Sl. sol. in H_2O. Decomp. by much H_2O. (Vortmann.)

—— **nitrate,** $Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_4+H_2O$.

Decomp. by H_2O.

$Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_4$, HNO_3+2H_2O. Decomp. by H_2O.

—— **nitratosulphate,** $Co_2(NH_3)_{10}(OH)(O.OH)(SO_4)(NO_3)_2$, $4HNO_3$.

Decomp. at once by H_2O.

Oxycobaltamine sulphate, $Co_2(NH_3)_{10}O_2(SO_4)_2$, $H_2SO_4+H_2O$.

Very sl. sol. in H_2O with decomp.; more easily sol. in acidified H_2O. Sol. in acids. (Maquenne, C. R. **96.** 344.)

$Co_2(NH_3)_{10}\left(\substack{OH\\O(OH)}\right)(SO_4)_2+3H_2O$.

$Co_2(NH_3)_{10}\left(\substack{OH\\O(OH)}\right)(HSO_4)_4$. Decomp. violently by H_2O.

Oxygen, O_2.

100 vols. H_2O absorb 4·6 vols. O gas at ord. temp. (Otto-Graham.)

Sol. in 27 pts. H_2O at ord. temp. (Pelouze and Fremy.)

100 vols. H_2O dissolve 0·925 vol. O. (Gay-Lussac.)

1 vol. H_2O at t° and 760 mm. absorbs V vols. O gas, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0·04114	7	0·03465	14	0·03034
1	0·04007	8	0·03389	15	0·02989
2	0·03907	9	0·03317	16	0·02949
3	0·03810	10	0·03250	17	0·02914
4	0·03717	11	0·03189	18	0·02884
5	0·03628	12	0·03133	19	0·02858
6	0·03544	13	0·03082	20	0·02838

(Bunsen's Gasometry.)

Coefficient of absorption of O by $H_2O = 0·04115 - 0·0010899t + 0·000022563t^2$. (Bunsen and Pauli, A. **93.** 21.)

Coefficient of absorption of O in H_2O at 6·4° = 0·041408; at 12·6° = 0·036011. (Timofejew, Z. phys. Ch. **6.** 148.)

Absorption of O by H_2O. β_1 = "solubility," *i.e.* the amount of gas (reduced to 0° and 760 mm.) which is absorbed by 1 vol. of the liquid when the barometer indicates 760 mm. pressure; β = coefficient of absorption, *i.e.* amount absorbed by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm.; $\beta_1=\beta\frac{760-f}{760}$, when f = vapour tension of solvent at t°.

t°	β	β_1
0	0·04890	0·04860
1	4759	4728
2	4633	4601
3	4512	4479
4	4397	4362
5	4286	4250
6	4181	4142
7	4080	4040
8	3983	3941
9	3891	3847
10	3802	3756
11	3718	3670
12	3637	3587
13	3560	3507

Absorption of O by H_2O, etc.—*Continued.*

t°	β	β_1
14	0·03486	0·03431
15	3415	3358
16	3347	3288
17	3283	3220
18	3220	3155
19	3161	3093
20	3102	3031
21	3044	2970
22	2988	2911
23	2934	2853
24	2881	2797
25	2831	2743
26	2783	2691
27	2736	2641
28	2691	2592
29	2649	2545
30	2608	2500
31	2572	2459
32	2537	2419
33	2503	2380
34	2471	2342
35	2440	2306
36	2410	2270
37	2382	2236
38	2355	2203
36	2330	2171
40	2306	2140
41	2280	2107
42	2256	2075
43	2232	2043
44	2209	2012
45	2187	1981
46	2166	1952
47	2145	1922
48	2126	1894
49	2108	1865
50	2090	1837
52	2057	1782
54	2026	1728
56	1998	1674
58	1971	1619
60	1946	1565
62	1921	1508
64	1897	1450
66	1874	1392
68	1853	1332
70	1833	1270
72	1815	1208
74	1799	1144
76	1785	1078
78	1772	1010
80	1761	0939
82	1752	0865
84	1743	0788
86	1736	0707
88	1729	0622
90	1723	0532
92	1717	0437
94	1712	0337
96	1708	0231
98	1704	0119
100	1700	0000

(Winkler, B. **24.** 3609.)

Absorption of O by H_2O at t° and 760 mm.
β=coefficient of absorption.

t°	β	t°	β	t°	β
0	0·04961	23	0·03006	46	0·02163
1	4838	24	2956	47	2139
2	4720	25	2904	48	2115
3	4606	26	2855	49	2092
4	4496	27	2808	50	2070
5	4389	28	2762	51	2049
6	4286	29	2718	52	2029
7	4186	30	2676	53	2009
8	4089	31	2635	54	1990
9	3994	32	2596	55	1972
10	3903	33	2558	56	1955
11	3816	34	2521	57	1938
12	3732	35	2486	58	1922
13	3651	36	2452	59	1907
14	3573	37	2419	60	1893
15	3497	38	2387	65	1832
16	3425	39	2356	70	1787
17	3357	40	2326	75	1752
18	3292	41	2297	80	1726
19	3230	42	2269	85	1707
20	3171	43	2241	90	1693
21	3114	44	2214	95	1684
22	3059	45	2188	100	1679

(Bahr and Bock, W. Ann. (2) **44.** 318.)

For O absorbed from the air, see also air, atmospheric, p. 1.

1 vol. alcohol absorbs 0·28397 vol. O at all temperatures between 0° and 24°. (Bunsen.)

Absorption by alcohol (99·7 %) at t°.
β=coefficient of absorption;
β_1=solubility. (See p. 276.)

t°	β	β_1
0	0·23370	0·22978
1	0·23296	0·22878
2	0·23222	0·22777
3	0·23149	0·22675
4	0·23077	0·22572
5	0·23005	0·22469
6	0·22934	0·22365
7	0·22863	0·22260
8	0·22793	0·22155
9	0·22724	0·22047
10	0·22656	0·21937
11	0·22588	0·21827
12	0·22521	0·21715
13	0·22455	0·21601
14	0·22389	0·21484
15	0·22324	0·21365
16	0·22259	0·21245
17	0·22195	0·21122
18	0·22132	0·20994
19	0·22069	0·20862
20	0·22007	0·20733
21	0·21946	0·20600
22	0·21886	0·20459
23	0·21826	0·20317
24	0·21767	0·20172

(Timofejew, Z. phys. Ch. **6.** 151.)

Insol. in ether.

Abundantly absorbed by oil of turpentine. Oil of turpentine absorbs its own vol. O when exposed two weeks to the air, but does not give it off on boiling. (Brandes.)

Absorbed by other oils, but this is decomposition rather than absorption, as the oils are oxidised. (See Storer's Dict.)

100 vols. arterial blood dissolve 10-13 vols. O. (Magnus.)

Coefficient of absorption for petroleum = 0·202 at 20°; 0·229 at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Oxy*di*mercuriammonium bromate, $(NHg_2OH_2)BrO_3$.

(Rammelsberg, Pogg. **55.** 82.)

—— **carbonate,** $(NHg_2OH_2)_2CO_3 + \frac{1}{2}H_2O$.

Insol. in H_2O. Decomp. by HCl + Aq only when conc. Not decomp. by boiling KOH + Aq. Decomp. by KI or K_2S + Aq. (Hirzel.)

$+H_2O$. As above. (Hirzel.)

—— **chloride,** $(NHg_2OH_2)Cl$.

Is *di*mercuriammonium chloride, $NHg_2Cl + H_2O$, which see.

—— **oxy*tri*mercuriammonium chloride,** $(NHg_2OH_2)Cl$, $(NHg_3O_2H_2)Cl$ (?).

Insol. in H_2O. Easily sol. in dil. HCl + Aq. More difficultly sol. in very dil. H_2SO_4 or HNO_3 + Aq. Insol. in conc. H_2SO_4. Sol. in boiling NH_4Cl + Aq, or $(NH_4)_2SO_4$ + Aq. Decomp. by KOH + Aq. (Schmieder.)

—— **chromate,** $(NHg_2OH_2)_2CrO_4$.

Not decomp. by KOH + Aq. (Hirzel, J. B. **1852.** 421.)

—— **mercuric chromate,** $(NHg_2OH_2)_2CrO_4$, $4HgO$, $3CrO_3$.

Decomp. by HNO_3 without going into solution. Easily sol. in HCl. (Hirzel.)

Composition is $(NHg_2OH_2)_2O$, $2CrO_3$, $3[(NH_4)_2O$, $2Cr_2O_3] = (NHg_2OH_2)_2Cr_2O_7$, $3(NH_4)_2Cr_2O_7$. (Hensgen, R. t. c. **5.** 187.)

Probably $(NHg_2)_2Cr_2O_7$, $3(NH_4)_2Cr_2O_7 + 2H_2O$.

—— **fluoride, acid,** $(NHg_2OH_2)F$, HF.

(Finkener, Pogg. **110.** 632.)

Probably NHg_2F, $HF + H_2O$.

—— **hydroxide,** $(NHg_2OH_2)OH = NHg_2OH + H_2O$.

(Millon's base.) Sl. sol. in H_2O, especially if warm. Sol. in 13,000 pts. H_2O at 17°, and 1700 pts. at 80°. Insol. in alcohol or ether. (Gerresheim, A. **195.** 373.)

$+H_2O$. Insol. in H_2O or alcohol. Sol. in traces in NH_4OH + Aq. Not decomp. by cold KOH + Aq; sl. decomp. if hot. (Millon.)

—— **ammonium iodate,** $(NHg_2OH_2)IO_3$, $2NH_4IO_3$.

Insol. in H_2O. (Millon, A. ch. (3) **18.** 410.)

—— **iodide,** $(NHg_2OH_2)I$.

Sol. in warm HCl + Aq. Not decomp. by boiling KOH + Aq. Sol. in warm KI + Aq. (Rammelsberg, Pogg. **48.** 170.)

Correct formula is $NHg_2I + H_2O$. (Rammelsberg.)

Oxy*di*mercuriammonium nitrate, $(NHg_2OH_2)NO_3$.

Insol. in H_2O; not decomp. by boiling KOH + Aq. Sol. in cold HCl + Aq, from which it is precipitated by H_2O. Sl. sol. without decomp. in HNO_3 or H_2SO_4 + Aq. Easily sol. in NH_4OH + Aq. (Soubeiran.)

Is *di*mercuriammonium nitrate, NHg_2NO_3. (Pesci, Gazz. ch. it. **20.** 485.)

—— **ammonium nitrate,** $(NHg_2OH_2)NO_3$, $2NH_4NO_3 + H_2O$.

Decomp. by H_2O. (Kane, A. ch. **72.** 242.)

Is *di*mercuriammonium ammonium nitrate, NHg_2NO_3, $2NH_4NO_3 + 2H_2O$. (Pesci.)

—— **oxide,** $(NHg_2OH_2)_2O$.

Insol. in H_2O or alcohol; not attacked by boiling conc. KOH + Aq. Sol. in hot NH_4NO_3 + Aq, NH_4Cl + Aq, $(NH_4)_2SO_4$ + Aq, $NH_4C_2H_3O_2$ + Aq, $(NH_4)_2C_2O_4$ + Aq. (Millon, A. ch. (3) **18.** 397.)

—— **mercuric phosphate,** $Hg(NHg_2OH_2)PO_4$.

Insol. in H_2O. Slowly sol. in hot HNO_3 + Aq; not decomp. by boiling with KOH + Aq, but by KI or K_2S + Aq. Sol. in HCl + Aq or much hot $(NH_4)_2HPO_4$ + Aq. (Hirzel.)

—— **mercuric sulphite,** $(NHg_2OH_2)_2SO_3$, $HgSO_3$.

Insol. in H_2O. Sol. in much $(NH_4)_2SO_3$ + Aq. Sol. in HCl + Aq with decomposition. Insol. in boiling KOH + Aq. (Hirzel.)

—— **sulphate,** $(NHg_2OH_2)_2SO_4$.

Sol. in traces in H_2O. Easily sol. in HCl or HNO_3 + Aq. (Kane.)

Insol. in HNO_3 + Aq. (Hirzel.)

Slowly sol. in boiling conc. H_2SO_4. (Hirzel.)

Insol. in conc., easily sol. in dil. H_2SO_4 + Aq. (Schmieder, J. pr. **75.** 147.)

Moderately sol. in much $(NH_4)_2SO_4$ or boiling NH_4Cl + Aq. Not decomp. by boiling KOH + Aq. (Hirzel.)

Easily decomp. by boiling with dil. KOH + Aq. (Schmieder.)

Does not exist. (Pesci.)

$2NH_3$, $2HgO$, SO_3.

*See Di***mercuriammonium sulphate.**

Oxy*tri*mercuriammonium chloride, $(NHg_3O_2H_2)Cl$ (?).

Insol. in H_2O.

—— **nitrate,** $(NHg_3O_2H_2)NO_3$.

Sol. in cold HCl + Aq, from which it is precipitated by NH_4OH + Aq. Sol. in NH_4OH + Aq without decomp. Not decomp. by H_2SO_4 or warm KOH + Aq. (Pagenstecher.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

Oxy*tri*mercuri*di*ammonium sulphate, $2NH_3$, $3HgO$, SO_3.

*See Tri***mercurammonium sulphate.**

Oxy*tri*mercurioxy*di*mercuriammonium sulphate, $\begin{matrix}NH_2Hg_3O_2\\NH_2Hg_2O\end{matrix}>SO_4$.

Completely sol. in NH_4Cl+Aq, or $(NH_4)_2SO_4$+Aq. Sol. in dil. or conc. HCl+Aq, and very dil. H_2SO_4+Aq. Insol. in HNO_3+Aq or conc. H_2SO_4. (Schmieder.)

Does not exist. (Pesci.)

Oxy*tetra*mercuriammonium mercuric nitrate (?), $2(NHg_4O_2)NO_3$, $HgNO_3$ (?).

Completely insol. in HNO_3+Aq. Sol. in warm HCl+Aq. Slowly decomp. by boiling KOH+Aq. Gradually sol. in hot conc. NH_4NO_3+Aq. (Hirzel.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

Oxynitrosulphonic anhydride, $S_2O_5<\begin{matrix}NO_2\\ONO_2\end{matrix}$ (?).

Sol. in H_2O with decomp. (Weber, Pogg. **123.** 339.)

Oxyosmiumamine hydroxide (Osmosyl*di*amine hydroxide), $OsO(NH_3OH)_2$.

Insol. in H_2O. Sl. sol. in acids. Sol. in KOH+Aq. When moist, sol. in NH_4OH+Aq.

Oxyosmium*di*amine chloride (Osmyl*tetr*amine chloride), $OsO_2(N_2H_6Cl)_2$.

Sl. sol. in cold, more easily in hot H_2O. Insol. in NH_4Cl+Aq. (Gibbs, Am. Ch. J. **3.** 233.)

—— **chloroplatinate,** $OsO_2(N_2H_6Cl)_2$, $PtCl_4$.

Sl. sol. in H_2O. (Gibbs.)

—— **hydroxide,** $OsO_2(N_2H_6OH)_2$.

Known only in solution.

—— **nitrate,** $OsO_2(N_2H_6NO_3)_2$.

—— **sulphate,** $OsO_2(N_2H_6)_2SO_4+H_2O$.

(Gibbs, Am. Ch. J. **3.** 233.)

Oxyphosphuretted hydrogen (?), $P_4H(OH)$.

P_4O of Leverrier, and Goldschmidt has this formula according to Franke (J. pr. (2) **35.** 341). Decomp. slowly by H_2O or alkalies. Forms potassium salt, $P_4H(OK)$, sol. in H_2O.

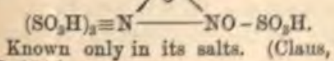
—— **hydroiodide,** $P_4H(OH)$, HI.

Decomp. at 80°.

Oxysulpharsenic acid.

See **Sulphoxyarsenic acid.**

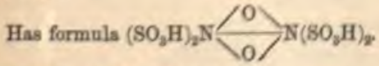
Oxysulphazotic acid, $H_4S_4N_2O_{14}$=



$(SO_3H)_3\equiv N\overset{O}{\triangle}NO-SO_3H.$

Known only in its salts. (Claus, A. **158.** 52, 194.)

Has formula



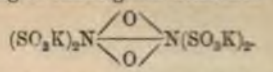
$(SO_3H)_2N<\begin{matrix}O\\O\end{matrix}>N(SO_3H)_2$.

(Raschig, A. **241.** 161.)

Potassium oxysulphazotate, $NO(SO_3K)_2$.

Insol. in alcohol. (Fremy, A. ch. (3) **15.** 451.)

According to Raschig the formula is



$(SO_3K)_2N<\begin{matrix}O\\O\end{matrix}>N(SO_3K)_2$.

Very sol. in water, with rapid decomposition. (Raschig.)

Oxysulphotungstates.

See **Sulphotungstates.**

Oxysulphovanadic acid.

See **Sulphoxyvanadic acid.**

Ozone, O_3.

Not appreciably sol. in H_2O. (Schönbein.)

Imparts its taste and properties to H_2O. (Williamson.)

Later, Carius (B. **5.** 520) found that 1000 vols. H_2O at 1-2·5° absorb 5·11 vols. O_3 (red. to 0° and 760 mm.). He also still later (A. **174.** 1) found, by conducting the gas for 9-12 hours through H_2O, that 1000 vols. H_2O absorb a maximum of 28·160 vols. O_3. The ozonised oxygen used contained 3·44 vols. O_3 in 100 vols. O_2. Since gases are absorbed in proportion to their partial pressure, which is very small for the O_3, the amount of absorption of water for the gas is very considerable. Carius calculated the coefficient of absorption at +1° to be 0·834.

Ozone is *not at all* absorbed by H_2O; the H_2O through which ozone had been passed gave no reactions for ozone. (Rammelsberg, B. **6.** 603.)

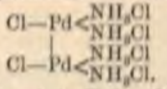
Schöne (B. **6.** 1224) corroborates Carius, and finds 8·81 vols. to 1000 vols. H_2O as a maximum amount absorbed.

Sol. in H_2O. (Leeds, B. **12.** 1831.)

Sol. in $H_2C_2O_4$+Aq. (Jeremin, B. **11.** 988.)

Completely absorbed by oil of turpentine and oil of cinnamon. (Soret, A. ch. (4) **17.** 113.)

***Di*palladamine chloride,** $Cl_2Pd_2(NH_3)_4Cl_4$=



$\begin{matrix}Cl-Pd<\begin{matrix}NH_3Cl\\NH_3Cl\end{matrix}\\ |\\ Cl-Pd<\begin{matrix}NH_3Cl\\NH_3Cl.\end{matrix}\end{matrix}$

Sl. sol. in H_2O. (Deville and Debray, C. R. **86.** 296.)

Palladium, Pd.

Not attacked by H_2O. Sl. attacked by HCl+Aq, but Pd sponge or filings are easily dissolved in warm HCl+Aq, with access of air. HNO_3+Aq of 1·2 sp. gr. dissolves Pd slightly, but it is easily sol. in HNO_3+Aq of 1·35 sp. gr. (Rose.)

Easily sol. in aqua regia. Sl. sol. in conc., but insol. in dil. HI+Aq. Sol. in conc. boiling H_2SO_4. Sol. in boiling $FeCl_3$+Aq. Sol. in HBr+Aq with a little HNO_3.

Palladium ammonium compounds.

See—

***Di*palladamine comps.,**		$Cl_2Pd_2(NH_3)_4Cl_4$.
Pallado*di*amine	,,	$Pd(NH_3)_4Cl_2$.
Palladosamine	,,	$Pd(NH_3)_2Cl_2$.

Palladium *di*bromide.

Not known in pure state.

Palladium bromide *with* MBr.

See **Bromopalladite, M.**

Palladium *sub*chloride, Pd_2Cl_2.

Deliquescent. Decomp. by H_2O, NH_4Cl, KI, or NH_4OH + Aq. (Kane.)

Palladium *di*chloride, $PdCl_2$.

Slowly but completely sol. in H_2O.

+ $2H_2O$. Not deliquescent when pure. Slowly sol. in H_2O. Much more sol. in H_2O containing HCl.

Palladium *di*chloride *with* MCl.

See **Chloropalladite, M.**

Palladium *tetra*chloride *with* MCl.

See **Chloropalladate, M.**

Palladious phosphorus chloride, $PdCl_2$, PCl_3.

Decomp. by H_2O into deliquescent $P(OH)_3$, $PdCl_2$. Decomp. by alcohol. (Fink, C. R. **115**. 176.)

$PdCl_2$, $2PCl_3$. Sol. in C_6H_6, and decomp. by H_2O. (Fink.)

Palladium *di*fluoride, PdF_2.

Sl. sol. in H_2O or HF + Aq. Sl. sol. while moist in NH_4OH + Aq; insol. after drying in NH_4OH + Aq. Insol. in boiling NaF or $NaHF_2$ + Aq. (Berzelius.)

Palladium hydride, Pd_2H (?).

Palladious hydroxide, PdO, xH_2O (?).

Easily sol. in acids or excess of alkali hydrates, and carbonates + Aq. Sol. in hot NH_4Cl + Aq. (Rose.)

Insol. in $Na_2B_4O_7$, and Na_2HPO_4 + Aq. (Claus.)

Palladic hydroxide, PdO_2, xH_2O.

Slowly sol. in acids. Sol. in conc. HCl + Aq without decomp. With dil. HCl + Aq, Cl_2 is evolved. (Berzelius.)

Palladious iodide, PdI_2.

Insol. in H_2O. Can be detected as a brown coloration in presence of 400,000 pts. H_2O. (Lassaigne.)

Sl. sol. in HI + Aq. Easily sol. in KI + Aq. (Lassaigne, J. ch. méd. **11**. 57.)

Insol. in dil. HCl + Aq, but slightly sol. in saline solutions. (Fresenius.)

Sl. sol. in hot conc. HNO_3 + Aq. Sol. in H_2SO_3 + Aq, Cl_2 + Aq, Br_2 + Aq, I_2 + Aq, and CN + Aq; also in HCN, and MCN + Aq. Insol. in dil. H_2SO_4, HCl, H_3PO_4, HNO_3, or $HC_2H_3O_2$ + Aq, or in the K, Na, or NH_4 salts of those acids. Insol. in $CuCl_2$, $ZnCl_2$, or $Pb(C_2H_3O_2)_2$ + Aq. Insol. in KBr + Aq except in presence of a free mineral acid, but not $HC_2H_3O_2$. Insol. in sugar or starch + Aq, uric acid, alcohol, ether, or oil of lemon. Somewhat sol. in urine. Easily sol. in NH_4OH + Aq, even when dil., with evolution of heat and decomposition. (Kersten, A. **87**. 28.)

Insol. in alcohol or ether.

Palladious potassium iodide.

See **Iodopalladite, potassium.**

Palladium *sub*oxide, Pd_2O.

Decomp. by acids into palladious salt and Pd. (Kane, Phil. Trans. **1842**, **1**. 276.)

Insol. in acids, even boiling aqua regia. (Willm. B. **25**. 220.)

Palladious oxide, PdO.

Slowly sol. in acids by boiling. (Wöhler, A. **174**. 160.)

Palladic oxide, PdO_2.

Very sl. attacked by acids.

Palladiopalladic oxide, 4PdO, PdO_2.

Not attacked by aqua regia. (Schneider, Pogg. **141**. 528.)

Palladious oxychloride, 3PdO, $PdCl_2$ + $4H_2O$ (?).

Sol. in dil. acids. (Kane.)

Palladious oxychloride ammonia, PdO, $PdCl_2$, $6NH_3$ (?).

Sol. in HCl + Aq.

3PdO, $PdCl_2$, $2NH_3$ + $3H_2O$ (?). Ppt. (Kane.)

Palladium selenide, PdSe.

Insol. in HNO_3 and aqua regia. (Rössler, A. **180**. 240.)

Palladium *sub*sulphide, Pd_2S.

Not attacked by acids except aqua regia, which attacks slightly. (Schneider, Pogg. **141**. 530.)

Palladium *mono*sulphide, PdS.

Insol. in H_2O or $(NH_4)_2S$ + Aq. Sol. in HCl + Aq. Pptd. in presence of 10,000 pts. H_2O. (Fellenberg, Pogg. **50**. 65.)

Sol. in potassium thiocarbonate + Aq. (Rosenbladt, Z. anal. **26**. 15.)

A sol. colloidal form was obtained in very dilute solution. (Winnsinger, Bull. Soc. (2) **49**. 452.)

Does not exist. (Kritschenko, Z. anorg. **4**. 247.)

Palladium *di*sulphide, PdS_2.

HNO_3 dissolves out part of the S. Easily sol. in aqua regia without separation of S. (Schneider.)

Palladium sulphide *with* M_2S.

See **Sulphopalladate, M.**

Pallado*di*amine bromide, $Pd(N_2H_6Br)_2$.

Easily sol. in H_2O.

—— **bromopalladite,** $Pd(N_2H_6Br)_2$, $PdBr_2$.

Properties as the corresponding chloropalladite.

—— **carbonate.**

Sol. in H_2O.

—— **chloride,** $Pd(N_2H_6Cl)_2$.

Easily sol. in H_2O.

—— **chloropalladite,** $Pd(N_2H_6Cl)_2$, $PdCl_2$.

"Vauquelin's red salt." Insol. in cold H_2O. (Fischer.)

Sol. in boiling H_2O with decomp. Sol. in HCl or HNO_3 + Aq.

Pallado*di*amine fluoride.
Easily sol. in H_2O. (Müller.)

—— **fluosilicate.**
Sl. sol. in cold, easily in warm H_2O. Insol. in alcohol.

—— **hydroxide,** $Pd(N_2H_6OH)_2$.
Sol. in H_2O.

—— **iodide,** $Pd(N_2H_6I)_2$.
Sol. in H_2O.

—— **nitrate,** $Pd(N_2H_6NO_3)_2$.
Easily sol. in H_2O, HNO_3, or NH_4OH + Aq. Insol. in alcohol.

—— **palladious nitrite,** $Pd(N_2H_6NO_2)_2$, $Pd(NO_2)_2$.
Easily sol. in H_2O.

—— **sulphate,** $Pd(N_2H_6)_2SO_4 + H_2O$.
Easily sol. in H_2O. Insol. in alcohol.

—— **sulphite,** $Pd(N_2H_6)_2SO_3$.
Sl. sol. in H_2O.

Palladochloronitrous acid.

Potassium palladochloronitrite, $Pd(NO_2)_2Cl_2K_2$.
Sol. in 2 pts. hot, and 3 pts. cold H_2O. (Vézes, C. R. **115**. 111.)

Palladocyanhydric acid.

Ammonium palladocyanide, $(NH_4)_2Pd(CN)_4$ (?).
Sol. in hot H_2O. (Rössler, Z. Ch. **1866**. 175.)

Barium ——, $BaPd(CN)_4 + 4H_2O$.
Not efflorescent. Sol. in H_2O.

Calcium ——, $CaPd(CN)_4 + 4H_2O$.
Sol. in H_2O.

Cupric ——, $CuPd(CN)_4$.
Ppt.

Lead ——, $PbPd(CN)_4$.
Ppt.

Magnesium ——, $MgPd(CN)_4$.
Very sol. in H_2O.

Magnesium —— **platinocyanide,** $MgPd(CN)_4$, $MgPt(CN)_4 + 14H_2O$.
Extremely sol. in H_2O.

Potassium ——, $K_2Pd(CN)_4 + 3H_2O$.
Efflorescent. Sol. in H_2O.
$+ H_2O$. Not efflorescent.

Silver ——, $Ag_2Pd(CN)_4$.
Ppt.

Sodium, —— $Na_2Pd(CN)_4$.
Not efflorescent. Sol. in H_2O.
$+ H_2O$.

Palladonitrous acid.

Potassium palladonitrite, $K_2Pd(NO_2)_4 + 2H_2O$.
Efflorescent; sol. in H_2O. (Lang, J. pr. **83**. 415.)

Silver palladonitrite, $Ag_2Pd(NO_2)_4$.
Easily sol. in hot H_2O. (Lang.)

Sodium ——, $Na_2Pd(NO_2)_4$.
(Fischer.)

Palladosamine bromide, $Pd(NH_3Br)_2$.

Insol. in cold, sl. sol. in hot H_2O. Easily sol. in $HC_2H_3O_2$, H_2SO_3, KOH, NH_4OH, or alkali carbonates + Aq. (Müller, A. **86**. 341.)

—— **carbonate,** $Pd(NH_3)_2CO_3$.
Moderately sol. in H_2O.

—— **chloride,** $Pd(NH_3Cl)_2$.
Insol. in H_2O, but very gradually decomp. by boiling therewith.
Sol. in warm HCl or HNO_3 + Aq. Sol. in cold NH_4OH + Aq. Sol. in KOH + Aq without evolution of NH_3.
$+ 2H_2O$. Efflorescent. Insol. in H_2O. (Baubigny, A. Suppl. **4**. 253.)

—— **cyanide,** $Pd(NH_3CN)_2$.
Sol. in NH_4OH + Aq.

—— **fluoride.**
Known only in solution.

—— **hydroxide,** $Pd(NH_3OH)_2$.
Easily sol. in H_2O. Slowly decomp. by boiling with H_2O. (Müller, A. **86**. 341.)

—— **iodide,** $Pd(NH_3I)_2$.
Insol. in H_2O. Sol. in boiling HNO_3 with evolution of I_2. (Fehling, A. **39**. 116.)

—— **nitrate.**
Known only in solution, which decomp. on evaporation.

—— **nitrite,** $Pd(NH_3NO_2)_2$.
Moderately sol. in H_2O. (Lang.)

—— **palladious nitrite,** $Pd(NH_3NO_2)_2$, $Pd(NO_2)_2$.
Slowly sol. in cold, easily in hot H_2O. (Lang.)

—— **sulphate,** $Pd(NH_3)_2SO_4$.
Moderately sol. in H_2O. (Müller.)

—— **sulphite,** $Pd(NH_3)_2SO_3$.
Easily sol. in H_2O. (Müller.)

Pentamine chromium compounds.

See—
Bromopurpureochromium compounds.
Chloropurpureochromium compounds.
Iodopurpureochromium compounds.
Xanthochromium compounds.
Roseochromium compounds.

Pentamine cobaltic compounds.

See—
Bromopurpureocobaltic compounds.
Chloropurpureocobaltic compounds.
Nitratopurpureocobaltic compounds.
Nitritocobaltic compounds.
Purpureocobaltic compounds.
Roseocobaltic compounds.
Sulphatopurpureocobaltic compounds.
Xanthocobaltic compounds.

Pentamine *di*cobaltic sulphite,

$2Co_2(NH_3)_5(SO_3)_3 + 9H_2O =$
$Co_2(NH_3)_{10}(SO_3)_3, Co_2(SO_3)_3 + 9H_2O$.

See **Roseocobaltic cobaltic sulphite.**

Pentamine iridium compounds.

See **Irido*pent*amine,** *and* **Iridoaquo*pent*amine compounds.**

Pentamine rhodium compounds.

See—
Bromopurpureorhodium compounds.
Chloropurpureorhodium compounds.
Iodopurpureorhodium compounds.
Nitratopurpureorhodium compounds.
Roseorhodium compounds.
Xanthorhodium compounds.

Pentathionic acid, $H_2S_5O_6$.

Known only in aqueous solution.

Conc. solution is decomp. by boiling, but made stable by addition of acids.

Sp. gr. of aqueous solution of pentathionic acid at 22°:

Sp. gr.	1·233	1·320	1·474	1·506
% $H_2S_5O_6$	32·1	41·7	56	59·7

(Kessler, Pogg. **74.** 279.)

Does not exist. (Spring, Bull. Acad. roy. Belg.)

Existence proven by Smith (Chem. Soc. **43.** 355).

Barium pentathionate, $BaS_5O_6 + 2H_2O$.

Easily sol. in H_2O. Aqueous solution is precipitated by alcohol.

Contains $3H_2O$. (Lewes, C. N. **43.** 41.)

Barium pentathionate tetrathionate, $BaS_5O_6, BaS_4O_6 + 6H_2O$.

Easily sol. in H_2O. Not precipitated from aqueous solution by two vols. alcohol. (Ludwig, Arch. Pharm. (2) **51.** 264.)

Cupric pentathionate, $CuS_5O_6 + 4H_2O$.

Easily sol. in H_2O. (Debus, Chem. Soc. **53.** 360.)

Lead pentathionate, $PbS_5O_6 + 4H_2O$.

Ppt.

Potassium pentathionate, $K_2S_5O_6$.

Sol. in H_2O. (Rammelsberg, J. B. **1857.** 136.)

Solution decomposes very quickly when neutral, but is more stable in presence of salts or acids.

Sol. in about 2 pts. H_2O.

Insol. in alcohol. (Debus, Chem. Soc. **53.** 295.)

$+H_2O$. (Shaw, Chem. Soc. **43.** 351.)
$+1\frac{1}{2}H_2O$. (Debus, A. **244.** 76.)
$+2H_2O$. (Lewes, C. N. **43.** 41.)

Perbromic acid, $HBrO_4$.

Known only in aqueous solution, which can be concentrated to a thick liquid on water bath. Not decomp. by HCl, SO_2, or H_2S. (Kämmerer, J. pr. **85.** 452; **90.** 190.)

Does not exist. (Muir, C. N. **33.** 256; Macivor, C. N. **33.** 35.)

Barium perbromate, $Ba(BrO_4)_2$.

Very sl. sol. in boiling H_2O. (Kämmerer, J. pr. **90.** 190.)

Does not exist. (Wolfram, A. **198.** 95.)

Potassium perbromate, $KBrO_4$.

Less sol. in H_2O than $KBrO_3$, but more sol. than $KClO_4$. (Kämmerer, J. pr. **90.** 190.)

Does not exist. (Wolfram, A. **198.** 95.)

Silver perbromate, $AgBrO_4$.

Sl. sol. in cold, more abundantly in hot H_2O. (Kämmerer, J. pr. **90.** 190.)

Does not exist. (Wolfram, A. **198.** 95.)

Perbromoplatinocyanhydric acid,

$H_2Pt(CN)_4Br_2 + xH_2O$.

Deliquescent. Easily sol. in H_2O, alcohol, and ether. (Holst, Bull. Soc. (2) **22.** 347.)

Aluminum perbromoplatinocyanide, $Al_2[Pt(CN)_4Br_2]_3 + 22H_2O$.

Deliquescent. Very sol. in H_2O.

Ammonium ——, $(NH_4)_2Pt(CN)_4Br_2$.

Sol. in H_2O.

Barium ——, $BaPt(CN)_4Br_2 + 5H_2O$.

Very sol. in H_2O or alcohol.

Cadmium ——, $CdPt(CN)_4Br_2 + xH_2O$.

Very sol. in H_2O.

Calcium ——, $CaPt(CN)_4Br_2 + 7H_2O$.

Sol. in H_2O.

Cobaltous ——, $CoPt(CN)_4Br_2 + 5H_2O$.

Sol. in H_2O. Sl. sol. in alcohol.

Glucinum ——, $GlPt(CN)_4Br_2$.

Deliquescent. Sol. in H_2O.

Ferrous ——.

Very sl. sol. in H_2O.

Lead ——, $PbPt(CN)_4Br_2 + 2H_2O$.

Sl. sol. in H_2O.

Lithium ——, $Li_2Pt(CN)_4Br_2$.

Deliquescent. Sol. in H_2O.

Magnesium ——, $MgPt(CN)_4Br_2 + xH_2O$.

Sol. in H_2O.

Nickel ——, $NiPt(CN)_4Br_2 + xH_2O$.

Sl. sol. in H_2O. Sol. in $NH_4OH + Aq$.

Potassium ——, $K_2Pt(CN)_4Br_2$.

Sol. in H_2O.
$+2H_2O$. Efflorescent.

Sodium ——, $Na_2Pt(CN)_4Br_2$.

Deliquescent. Sol. in H_2O.

Strontium ——, $SrPt(CN)_4Br_2 + 7H_2O$.

Sol. in H_2O.

Zinc ——, $ZnPt(CN)_4Br_2 + 5H_2O$.

Not very sol. in H_2O.

Perchloric acid, $HClO_4$.

Combines with H_2O with a hissing sound and evolution of much heat.

Solution in H_2O is very stable.

When dil. $HClO_4 + Aq$ is distilled, H_2O and $HClO_4$ distil off until a temp. of 203° is reached, when an acid of constant composition containing 71·6-72·2 % $HClO_4$ (=$HClO_4$+$2H_2O$) is obtained. Forms hydrate $HClO_4$+H_2O, which is deliquescent, and dissolves in H_2O with evolution of much heat. $HClO_4$ is very unstable, $HClO_4+H_2O$ more stable, and $HClO_4+2H_2O$ is very stable. (Roscoe, A. **121.** 346.)

$HClO_4+2H_2O$ has 1·65 sp. gr. and boils at 200° (Serullas); has 1·72-1·82 sp. gr. and boils at 200° (Nativelle, J. pr. **26.** 405).

Sol. in alcohol with decomp., often explosive.

Perchlorates.

All perchlorates are sol. in H_2O, $KClO_4$, $RbClO_4$, and $CsClO_4$ somewhat difficultly. They are all deliquescent, and sol. in alcohol, excepting NH_4ClO_4, $KClO_4$, $Pb(ClO_4)_2$, and $Hg_2(ClO_4)_2$. (Serullas, A. ch. (2) **46.** 296.)

Aluminum perchlorate.

Deliquescent; sol. in H_2O and alcohol. (Serullas.)

Ammonium perchlorate, NH_4ClO_4.

Permanent. Sol. in 5 pts. H_2O; somewhat sol. in alcohol. (Mitscherlich, Pogg. **25.** 300.)

Insol. in conc. $HClO_4$+Aq.

Barium perchlorate, $Ba(ClO_4)_2+4H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Bismuth perchlorate, $(BiO)ClO_4$.

Insol. in H_2O. Easily sol. in HCl or HNO_3+Aq, less easily in H_2SO_4+Aq. (Muir, C. N. **33.** 15.)

Cadmium perchlorate, $Cd(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 305.)

Cæsium perchlorate, $CsClO_4$.

Very sl. sol. in H_2O. (Retgers, Z. phys. Ch. **8.** 17.)

Calcium perchlorate, $Ca(ClO_4)_2$.

Very deliquescent. Very sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 304.)

Cerous perchlorate, $Ce(ClO_4)_3+8H_2O$.

Very deliquescent. (Jolin.)

Cupric perchlorate, $Cu(ClO_4)_2$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 306.)

Cupric perchlorate ammonia, $Cu(ClO_4)_2, 4NH_3+2H_2O$.

Not deliquescent. Sol. in NH_4OH+Aq. (Roscoe, A. **121.** 346.)

Didymium perchlorate, $Di(ClO_4)_3+9H_2O$.

Very deliquescent. Very sol. in H_2O and alcohol. (Cleve.)

Erbium perchlorate, $Er(ClO_4)_3+8H_2O$.

Very deliquescent.

Glucinum perchlorate, $Gl(ClO_4)_2+4H_2O$.

Very deliquescent, and sol. in H_2O. (Atterberg.)

Ferrous perchlorate, $Fe(ClO_4)_2$.

Tolerably permanent; sol. in H_2O. (Serullas, *l.c.*)

Ferric perchlorate, $Fe(ClO_4)_3$.

Sol. in H_2O. (Serullas.)

Lanthanum perchlorate, $La(ClO_4)_3+9H_2O$.

Extremely deliquescent. Sol. in H_2O and absolute alcohol. (Cleve.)

Lead perchlorate, basic, $2PbO, Cl_2O_7+2H_2O$.

Decomp. by H_2O into an insol. more basic salt, and sol. $Pb(ClO_4)_2$. (Marignac.)

Lead perchlorate, $Pb(ClO_4)_2+3H_2O$.

Permanent; extremely easily sol. in H_2O. (Roscoe, A. **121.** 356.)

Sol. in about 1 pt. H_2O. (Serullas.)

Lithium perchlorate, $LiClO_4$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas.)

$+3H_2O$. (Wyrouboff, Zeit. Kryst. **10.** 626.

Magnesium perchlorate, $Mg(ClO_4)_2$.

Deliquescent, and sol. in H_2O and alcohol. (Serullas.)

Manganous perchlorate, $Mn(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 335.)

Mercurous perchlorate, $Hg_2(ClO_4)_2+6H_2O$.

Very deliquescent. (Roscoe, A. **121.** 356.)

Permanent. (Serullas.)

Mercuric perchlorate, $Hg(ClO_4)_2$.

Very deliquescent. Sol. in H_2O; sl. sol. with decomp. in alcohol. (Serullas, A. ch. **34.** 243.)

Nickel perchlorate.

Deliquescent; easily sol. in alcohol and H_2O. (Groth, Pogg. **133.** 226.)

Platinum perchlorate, $Pt_4ClO_9+15H_2O$.

Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Potassium perchlorate, $KClO_4$.

Sol. in 57·9 pts. H_2O at 21·3° (Longuinine, A. **121.** 123); in 65 pts. H_2O at 15° (Serullas, A. ch. (2) **46.** 297); in 88 pts. H_2O at 10°; in 55 pts. H_2O at 100° (Hutstein, J. B. **1851.** 331.)

Solubility in H_2O.

1 pt. $KClO_4$ dissolves in 142·9 pts. H_2O at 0°, and solution has sp. gr. = 1·0005; in 52·5 pts. H_2O at 25°, and solution has sp. gr. = 1·0123; in 15·5 pts. H_2O at 50°, and solution has sp. gr. = 1·0181; in 5·04 pts. H_2O at 100°, and solution has sp. gr. = 1·0660. (Muir, C. N. **33.** 15.)

$KClO_4$ is sol. in 22·0 pts. H_2O at ord. temp., and 4·00 pts. at 100°; in 29·6 pts. NH_4OH+Aq (conc.) at ord. temp.; in 30·4 pts. NH_4OH+Aq (1 vol. conc. + 3 vols. H_2O) at ord. temp.; in 22·4 pts. HNO_3+Aq (1 vol. conc. + 5 vols. H_2O) at ord. temp., and 5·00 pts. at 100°; in 30·4 pts. HCl+Aq (1 vol. conc. + 4 vols. H_2O) at ord. temp.; 45·2 pts. $HC_2H_3O_2$+Aq (1 vol. commercial acid + 1 vol. H_2O) at ord. temp.; in 24·4 pts. $NH_4C_2H_3O_2$+Aq. (dil. $HC_2H_3O_2$ + dil.

NH_4OH+Aq) at ord. temp., and 6·00 pts. at 100°; in 25·6 pts. NH_4Cl+Aq (1 pt. NH_4Cl+10 pts. H_2O) at ord. temp., and 6·00 pts. at 100°; in 16·0 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3+10 pts. H_2O) at ord. temp., and 4·00 pts. at 100°; in 25·6 pts. $NaC_2H_3O_2$+Aq (conc. $HC_2H_3O_2+Na_2CO_3$+4 vols. H_2O) at ord. temp., and 7·00 pts. at 100°; in 29·2 pts. $Cu(C_2H_3O_2)_2$+Aq (Stolba, Z. anal. **2.** 390) at ord. temp., and 7·00 pts. at 100°; in 27·2 pts. cane sugar (1 pt.+10 pts. H_2O) at ord. temp.; in 36·8 pts. grape sugar (1 pt.+10 pts. H_2O) at ord. temp. (Approximate.) (Pearson, Zeit. Chem. **1869.** 662.)

Very sl. sol. in abs. alcohol, and insol. if alcohol contains trace of an acetate. (Roscoe.) Insol. in alcohol of 0·835 sp. gr. (Schlösing, C. R. **73.** 1269.)

Sol. in 6400 pts. 97·2 % alcohol; in 5000 pts. 95·8 % alcohol; in 2500-3000 pts. 90 % alcohol; in 25,000 pts. alcohol-ether (2 pts. 97 % alcohol : 1 pt. ether). Practically insol. in an alcoholic solution of $HClO_4$. (Wenze, Z. angew. Ch. **1891.** 691.)

Rubidium perchlorate, $RbClO_4$.

Sol. in 92·1 pts. H_2O at 21·3°. (Longuinine, A. **121.** 123.)

Silver perchlorate, $AgClO_4$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 307.)

Sodium perchlorate, $NaClO_4$.

Deliquescent, and very sol. in H_2O and alcohol. (Serullas.)

Not deliquescent. (Potilitzin, J. russ. Soc. **1889,** **1.** 258.)

+H_2O. Not deliquescent. (Potilitzin.)

Strontium perchlorate, $Sr(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 304.)

Thallous perchlorate, $TlClO_4$.

1 pt. salt dissolves in 10 pts. H_2O at 15°, and 0·6 pt. at 100°. (Roscoe, Chem. Soc. (2) **4.** 504.)

Sl. sol. in alcohol. (Roscoe.)

Yttrium perchlorate, $Y(ClO_4)_3+8H_2O$.

Very deliquescent. Sol. in H_2O and alcohol. (Cleve.)

Zinc perchlorate, $Zn(ClO_4)_2$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 302.)

Perchromic acid.

Sodium perchromate, $Na_6Cr_2O_{15}+28H_2O$.

Efflorescent. Sl. sol. in cold, easily in hot H_2O, with decomp. Not decomp. by NaOH+Aq. (Häussermann, J. pr. (2) **48.** 70.)

Perchloroplatinocyanhydric acid, $H_2Pt(CN)_4Cl_2+4H_2O$.

Very sol. in H_2O and alcohol.

Ammonium perchloroplatinocyanide, $(NH_4)_2Pt(CN)_4Cl_2+2H_2O$.

Sol. in H_2O.

Barium perchloroplatinocyanide, $BaPt(CN)_4Cl_2+5H_2O$.

Very sol. in H_2O.

Calcium ——, $CaPt(CN)_4Cl_2$.

Sol. in H_2O.

Magnesium ——, $MgPt(CN)_4Cl_2+xH_2O$.

Sol. in H_2O.

Manganous ——, $MnPt(CN)_4Cl_2+5H_2O$.

Sol. in H_2O and alcohol.

Potassium ——, $K_2Pt(CN)_4Cl_2+2H_2O$.

Very efflorescent, and sol. in H_2O and alcohol.

Perferricyanhydric acid.

Potassium perferricyanide, $K_2Fe(CN)_6+H_2O$ (?).

Very hygroscopic, and sol. in H_2O. Nearly insol. in absolute alcohol. Decomp. by hot H_2O. (Skraup, A. **189.** 368.)

Periodic acid, H_5IO_6.

Deliquescent in moist air; very sol. in H_2O. (Bengieser, A. **17.** 254.)

Rather easily sol. in alcohol and ether. (Bengieser.)

Rather easily sol. in alcohol, less in ether. (Langtoch.)

Sl. sol. in alcohol, still less in ether. (Langlois, J. pr. **56.** 36.)

Sp. gr. of H_5IO_6+Aq.

$H_5IO_6+20H_2O=1·4008$.
$H_5IO_6+40H_2O=1·2165$.
$H_5IO_6+80H_2O=1·1121$.
$H_5IO_6+160H_2O=1·0570$.
$H_5IO_6+320H_2O=1·0288$.
(Thomsen, B. **7.** 71.)

Periodates.

Most periodates are insol. or sl. sol. in H_2O; all are insol. or very sl. sol. in alcohol, but they all dissolve in dil. HNO_3+Aq. (Bengieser.)

Ammonium ***meta*****periodate,** NH_4IO_4.

Sl. sol. in H_2O. Cryst. with $3H_2O$ (Ihre, B. **3.** 316), $2H_2O$ (Langlois, A. ch. (3) **34.** 257).

Ammonium ***dimeso*****periodate,** $(NH_4)_4I_2O_9+3H_2O$.

Sol. in H_2O. (Rammelsberg, Pogg. **134.** 379.)

Ammonium lithium ***dimeso*****periodate,** $(NH_4)_2Li_2I_2O_9+7H_2O$.

Sol. in H_2O. (Ihre.)

Ammonium magnesium ***meso*****periodate,** $NH_4MgIO_5+3H_2O$.

Precipitate. (Rammelsberg, Pogg. **134.** 510.)

Barium ***meta*****periodate,** $Ba(IO_4)_2$.

Known only in solution.

Barium ***dimeso*****periodate,** $Ba_2I_2O_9$.

Sl. sol. in H_2O; easily sol. in dil. HNO_3+Aq. (Rammelsberg, Pogg. **134.** 391.)

Cryst. also with $3H_2O$, $5H_2O$, and $7H_2O$.

Barium *meso*periodate, $Ba_3(IO_5)_2+6H_2O$.
(Ihre.)

Barium *ortho*periodate, $Ba_5(IO_6)_2$.
Insol. in H_2O. Sol. in HNO_3+Aq. (Rammelsberg.)

Barium *dimesodi*periodate, $Ba_5I_4O_{19}+5H_2O$.
Precipitate. Sol. in dil. HNO_3+Aq. (Rammelsberg, Pogg. **134.** 395.)

Cadmium *meta*periodate, $Cd(IO_4)_2$.
Ppt. (Rammelsberg, Pogg. **134.** 516.)

Cadmium *dimeso*periodate, $Cd_2I_2O_9+9H_2O$.
Insol. in H_2O. (Rammelsberg.)

Cadmium *meso*periodate, $Cd_3(IO_5)_2+5H_2O$.
Ppt.
$CdHIO_5$. (Kimmins, Chem. Soc. **55.** 151.)

Cadmium *di*periodate, $Cd_4I_2O_{11}+3H_2O$.
Insol. in H_2O. (Rammelsberg.)

Cadmium periodate, $Cd_{10}I_6O_{31}+15H_2O$.
Insol. in H_2O. (Rammelsberg.)

Calcium *meta*periodate, $Ca(IO_4)_2$.
Sol. in H_5IO_6+Aq and acids. (Rammelsberg, Pogg. **134.** 405.)

Calcium *dimeso*periodate, $Ca_2I_2O_9+7H_2O$, and $9H_2O$.
Sl. sol. in H_2O. (Rammelsberg.)
$+3H_2O$. (Langlois.)

Calcium *ortho*periodate, $Ca_5(IO_6)_2$.
Insol. in H_2O. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **44.** 577.)

Cobaltous periodate, $7CoO, 2I_2O_7+18H_2O$.
Attacked by HCl, and sol. on warming. Slowly but completely sol. in HNO_3. (Lautsch, J. pr. **100.** 89.)
Could not be obtained by Rammelsberg.

Cupric *dimeso*periodate, $Cu_2I_2O_9+6H_2O$.
Decomp. by H_2O without dissolving. (Rammelsberg.)

Cupric *ortho*periodate, Cu_2HIO_6.
Very sol. in HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 150.)

Cupric *di*periodate, $Cu_4I_2O_{11}+H_2O$.
Insol. in H_2O; sol. in dil. HNO_3+Aq. (Rammelsberg.)
$+7H_2O$. (R.)

Cupric periodate, $5CuO, I_2O_5+5H_2O$.
Wholly insol. in H_2O. (Rammelsberg, B. **1.** 73.)

Didymium periodate, $Di_2O_2(IO_4)_2$.
Precipitate.
$DiIO_5+4H_2O$. Ppt. (Cleve, Bull. Soc. (2) **43.** 362.)

Erbium periodate.
Sol. in H_2O. (Höglund.)

Glucinum periodate, $Gl_3(IO_5)_2+11H_2O$.
Decomp. by H_2O without dissolving. Easily sol. in HNO_3+Aq.
$+13H_2O$. Nearly insol. in H_2O. (Atterberg, B. **7.** 474.)

Ferrous *ortho*periodate, $Fe_5(IO_6)_2$.
(Kimmins, Chem. Soc. **55.** 150.)
FeH_3IO_6. (Kimmins.)

Ferric periodate, $2Fe_2O_3, I_2O_7+21H_2O$.
Ppt. (Rammelsberg.)

Ferric *dimeso*periodate, $FeHI_2O_9$.
Insol. in dil. HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 149.)

Ferric *meta*periodate, $Fe(IO_4)_3$.
(Kimmins.)

Lanthanum periodate, $La(IO_4)_3+2H_2O$.
Precipitate. (Cleve.)

Lead *meta*periodate, $Pb(IO_4)_2$.
Sol. in HNO_3+Aq. (Kimmins.)

Lead *ortho*periodate, $Pb_3H_4(IO_6)_2$.
Sol. in HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 149.)

Lead *meso*periodate, $Pb_3(IO_5)_2+2H_2O$.
Insol. in H_2O or excess of periodic acid+Aq. Decomp. by dil. H_2SO_4+Aq. (Bengieser, A. **17.** 254.)

Lithium *meta*periodate, $LiIO_4$.
Difficultly sol. in H_2O. (Rammelsberg, B. **1.** 132.)

Lithium *dimeso*periodate, $Li_4I_2O_9+3H_2O$.
Very sl. sol. in H_2O. (Rammelsberg, Pogg. **134.** 387.)

Lithium *ortho*periodate, Li_5IO_6.
H_2O dissolves out a slight amount of LiI. Easily sol. in HNO_3+Aq. (Rammelsberg, Pogg. **137.** 313.)

Magnesium *meta*periodate, $Mg(IO_4)_2+10H_2O$.
Easily sol. in H_2O. (Rammelsberg.)

Magnesium *di*periodate, $Mg_4I_2O_{11}+6H_2O$, or $9H_2O$.
Sl. efflorescent. Insol. in H_2O. (Rammelsberg.)

Magnesium *dimeso*periodate, $Mg_2I_2O_9+3H_2O$.
(Rammelsberg, Pogg. **134.** 499.)
$+15H_2O$. Insol. in H_2O. Sol. in periodic acid+Aq. (Langlois.)

Mercurous *di*periodate, $5Hg_2O, I_2O_7$, or $4Hg_2O, I_2O_7=Hg_8I_2O_{11}$.
Insol. in H_2O. Easily sol. in HNO_3+Aq and in HCl+Aq. (Lautsch, J. pr. **100.** 86.)

Mercuric *ortho*periodate, $Hg_5(IO_6)_2$.
Insol. in H_2O. Easily sol. in HCl. Sl. sol. in HNO_3. (Lautsch.)

Mercuric potassium periodate, $10HgO, 5K_2O, 6I_2O_7$.
Insol. in H_2O. Difficultly sol. in warm HNO_3 without decomp. (Rammelsberg, Pogg. **134.** 526.)

Nickel *dimeso*periodate, $Ni_2I_2O_9$.
(Kimmins, Chem. Soc. **55.** 151.)

Nickel *meso*periodate, $Ni_3(IO_5)_2$.
(Kimmins.)

Nickel periodate, $7NiO, 4I_2O_7+63H_2O$.
Insol. in H_2O. Easily sol. in H_5IO_6+Aq. (Rammelsberg, Pogg. **134**. 514.)

Potassium *meta*periodate, KIO_4.
Sl. sol. in H_2O. Sol. in 290 pts. cold H_2O. (Rammelsberg, Pogg. **134**. 320.)
Almost insol. in KOH+Aq.

Potassium *meso*periodate, $K_3IO_5+4H_2O$.
Deliquescent. Easily sol. in H_2O. (Ihre.)

Potassium *dimeso*periodate, $K_4I_2O_9+9H_2O$.
Sol. in 9·7 pts. cold H_2O. (Rammelsberg, Pogg. **134**. 320.)
Sol. in KOH+Aq.
$+3H_2O$.

Potassium hydrogen *dimeso*periodate, $K_3HI_2O_9$.
Less sol. in H_2O than KIO_4. (Kimmins, Chem. Soc. **51**. 356.)

Potassium zinc periodate, $K_2O, 4ZnO, 2I_2O_7+4H_2O$.
Ppt. (Rammelsberg, Pogg. **134**. 368.)

Samarium periodate, $Sm(IO_5)+4H_2O$.
Precipitate. (Cleve.)

Silver *meta*periodate, $AgIO_4$.
Decomp. by cold H_2O into $Ag_4I_2O_9+3H_2O$, and by warm H_2O into $Ag_4I_2O_9+H_2O$. (Ammermüller and Magnus, Pogg. **28**. 516.)
$+H_2O$. Insol. ppt. (Kimmins.)

Silver *meso*periodate, Ag_3IO_5.
(Fernlunds, J. pr. **100**. 99.)
Ag_2HIO_5. Insol. ppt. (Kimmins, Chem. Soc. **51**. 358.)

Silver *dimeso*periodate, $Ag_4I_2O_9+H_2O$, or $3H_2O$.
Insol. ppt. (Kimmins.)
Decomp. by boiling H_2O into Ag_5IO_6. (Rammelsberg.)

Silver *ortho*periodate, Ag_5IO_6.
Sol. in HNO_3 or NH_4OH+Aq. (Rammelsberg, Pogg. **134**. 386.)
$Ag_3H_2IO_6$. Insol. ppt. (Kimmins, Chem. Soc. **51**. 358.)
$Ag_2H_3IO_6$. As above. (Kimmins.)

Silver *di*periodate, $Ag_8I_2O_{11}$.
Sl. sol. in HNO_3+Aq; insol. in NH_4OH+Aq. (Lautsch, J. pr. **100**. 75.)

Silver *dimesodi*periodate, $Ag_{10}I_4O_{19}$.
HNO_3+Aq dissolves out Ag_2O. Insol. in NH_4OH+Aq. (Lautsch.)

Sodium *meta*periodate, $NaIO_4$.
Easily sol. in H_2O.
$+2H_2O$. (Langlois.)
$+3H_2O$. Efflorescent; sol. in 12 pts. H_2O at ord. temp. (Rammelsberg, J. pr. **103**. 278.)

Sodium *dimeso*periodate, $Na_4I_2O_9+3H_2O$.
Scarcely sol. in cold, sl. sol. in hot H_2O. (Magnus and Ammermüller, Pogg. **28**. 514.)
Very sol. in dil. HNO_3+Aq. (Langlois.)
Sol. in $HC_2H_3O_2$+Aq with decomp. (Bengieser, A. **17**. 254.)
$+4H_2O$.

Sodium *meso*periodate, $Na_3IO_5+\frac{1}{4}H_2O$.
Sol. in H_2O. (Ihre.)
$+H_2O=Na_3H_2IO_6$. Less sol. in H_2O than $Na_4I_2O_9+3H_2O(=Na_2H_3IO_6)$. (Kimmins, Chem. Soc. **51**. 357.)

Sodium *ortho*periodate, Na_5IO_6.
$Na_2H_3IO_6$. Correct composition for $Na_4I_2O_9+3H_2O$. (Kimmins.)
$Na_3H_2IO_6$. Correct composition for $Na_3IO_5+H_2O$. (Kimmins.)

Strontium *meta*periodate, $Sr(IO_4)_2+6H_2O$.
Sol. in H_2O.

Strontium *dimeso*periodate, $Sr_2I_2O_9$.
Decomp. by H_2O.
$+3H_2O$.

Strontium *meso*periodate, $Sr_3(IO_5)_2$.
Precipitate.

Strontium *ortho*periodate, $Sr_5(IO_6)_2$.
(Rammelsberg, Pogg. **44**. 577.)

Thallic periodate, $3Tl_2O_3, I_2O_7+30H_2O$.
Insol. in H_2O. Decomp. by alkalies. (Rammelsberg, B. **3**. 361.)

Thorium periodate.
Precipitate. Sol. in HNO_3+Aq.

Uranous periodate.
Precipitate, which quickly decomposes.

Yttrium periodate, $Y_2(IO_5)_2+8H_2O$.
Very slightly sol. (Cleve.)
$3Y_2O_3, 2I_2O_7+6H_2O$. Precipitate. (Cleve.)

Zinc *dimeso*periodate, $Zn_2I_2O_9+6H_2O$.
(Rammelsberg, Pogg. **134**. 513.)

Zinc periodate, $3ZnO, 2I_2O_7+7H_2O$.
(Langlois.)

Zinc *di*periodate, $Zn_4I_2O_{11}+H_2O$.
Easily sol. in H_2O, sl. acid with HNO_3. (Langlois, A. ch. (3) **34**. 257.)

Zinc *dimesodi*periodate, $Zn_5I_4O_{19}+14H_2O$ (?).
(Rammelsberg.)

Zinc periodate, $9ZnO, 2I_2O_7+12H_2O$.
(Rammelsberg.)

Periodoplatinocyanhydric acid.

Barium periodoplatinocyanide, $BaPt(CN)_4I_2+xH_2O$.
Easily sol. in H_2O or alcohol. (Holst, Bull. Soc. (2) **22**. 347.)

Potassium periodoplatinocyanide, $K_2Pt(CN)_4I_2$.
Permanent. Easily sol. in H_2O or alcohol.

Permanganic acid, $HMnO_4$.

Known only in solution, which decomposes by evaporation or warming.

Permanganates.

All permanganates are sol. in H_2O, excepting $AgMnO_4$, which is sl. sol.

Ammonium permanganate, NH_4MnO_4.

Sol. in 12·6 pts. H_2O at 15°. (Aschoff.)

Barium permanganate, $Ba(MnO_4)_2$.

Sol. in H_2O.

Cadmium permanganate ammonia, $Cd(MnO_4)_2, 4NH_3$.

Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 510.)

Calcium permanganate, $Ca(MnO_4)_2+5H_2O$.

Deliquescent.

Cupric permanganate.

Deliquescent.

Cupric permanganate ammonia, $Cu(MnO_4)_2, 4NH_3$.

Sol. in H_2O with slow decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Didymium permanganate, $Di(MnO_4)_3+21H_2O$.

Sl. sol. in H_2O. (Frerichs and Smith, A. **191.** 331.)

Has not been prepared. (Cleve, B. **11.** 912.)

Lanthanum permanganate, $La(MnO_4)_3+21H_2O$.

Ppt. (Frerichs and Smith, A. **191.** 331.)

Has not been prepared. (Cleve, B. **11.** 910.)

Lead permanganate.

Sol. in HNO_3+Aq. (Forchhammer.)

Lithium permanganate, $LiMnO_4+3H_2O$.

Sol. in 1·4 pts. H_2O at 16°. (Aschoff.)

Magnesium permanganate, $Mg(MnO_4)_2+6H_2O$.

Easily deliquescent.

Nickel permanganate ammonia, $Ni(MnO_4)_2, 4NH_3$.

Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Potassium permanganate, $KMnO_4$.

Sol. in 16 pts. H_2O at 15°. (Mitscherlich.)

Sol. in conc. H_2SO_4. Deliquesces in liquid HCl, but does not dissolve. (Gore.)

Slowly sol. in H_3PO_4+Aq. (Chevillot and Edwards.)

Decomp. immediately by alcohol.

Silver permanganate, Ag_2MnO_4.

Sol. in 109 pts. cold H_2O and much less hot H_2O. Decomp. by boiling. (Mitscherlich, Pogg. **25.** 301.)

Silver permanganate ammonia.

Sl. sol. in cold, more easily in hot H_2O. (Klobb, C. R. **103.** 384.)

Sodium permanganate, $NaMnO_4+3H_2O$.

Deliquescent. Extremely sol. in H_2O.

Strontium permanganate, $Sr(MnO_4)_2+4H_2O$.

Deliquescent. Sol. in H_2O. (Fromherz.)

Zinc permanganate.

Deliquescent. (Mitscherlich.)

Zinc permanganate ammonia, $Zn(MnO_4)_2, 4NH_3$.

Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Permolybdic acid, $Mo_2O_7, 5H_2O = HMoO_4 + 2H_2O$.

Very sol. in H_2O, and not decomp. by boiling. (Péchard, A. ch. (6) **28.** 550.)

Ammonium permolybdate, $NH_4MoO_4+2H_2O$.

Very sol. in H_2O; sl. sol. in alcohol, but alcohol extracts it from H_2O, forming a very conc. supersat. solution, which is pptd. by a crystal of NH_4MoO_4, and only a sl. amount remains in solution. (Péchard.)

Barium permolybdate, $Ba(MoO_4)_2+2H_2O$.

Copper permolybdate, $Cu(MoO_4)_2+H_2O$.

Insol. in H_2O; easily sol. in acids. Sol. in NH_4OH+Aq with decomp.

Magnesium permolybdate, $Mg(MoO_4)_2+10H_2O$.

Very sol. in H_2O; sl. sol. in alcohol. (Péchard.)

Mercurous permolybdate.

Insol. in H_2O or NH_4NO_3+Aq. (Péchard.)

Potassium permolybdate, $KMoO_4+2H_2O$.

Sl. sol. in cold, more in hot H_2O. Sl. sol. in alcohol. (Péchard.)

Silver permolybdate, $AgMoO_4$.

(Péchard.)

Sodium permolybdate, $NaMoO_4+3H_2O$.

Very sol. in H_2O; insol. in alcohol, but behaves similarly to K salt. (Péchard.)

Pernitric acid, NO_3.

See **Nitrogen *hex*oxide.**

Perosmic acid.

Potassium perosmate (?).

Sol. in H_2O, but very easily decomp.

Perstannic acid, $H_2Sn_2O_7$.

Known in colloidal state, sol. in H_2O. (Spring, Bull. Soc. (2) **51.** 180.)

Persulphuric acid, S_2O_7.

See **Sulphur *hept*oxide.**

$H_2S_2O_8$. Known only in its salts. (Marshall, Chem. Soc. **59.** 771.)

Ammonium persulphate, $(NH_4)_2S_2O_8$.

Very sol. in H_2O. 100 pts. H_2O at 0° dissolve 58·2 pts. $(NH_4)_2S_2O_8$. (Marshall, Chem. Soc. **59.** 771.)

Barium persulphate, $BaS_2O_8+4H_2O$.

Very sol. in H_2O. 100 pts. H_2O at 0° dissolve 39·1 pts. BaS_2O_8 or 52·2 pts. $BaS_2O_8+4H_2O$. Sol. in absolute alcohol with pptn. of $BaS_2O_8+H_2O$. Insol. in alcohol. (Marshall.)

Lead persulphate, $PbS_2O_8+3H_2O$.

Deliquescent. Very sol. in H_2O. (Marshall.)

Potassium persulphate, $K_2S_2O_8$.

100 pts. H_2O at 0° dissolve 1·77 pts. $K_2S_2O_8$;

more sol. in hot H_2O, with very sl. decomp. Less sol. in H_2O than any other persulphate. (Marshall.)

Pertungstic acid.

Sodium pertungstate, $NaWO_4+H_2O$.

Very sol. in H_2O. (Péchard, C. R. **112.** 1060.)

Peruranic acid, UO_6, xH_2O (?).

Known only in its salts.

Ammonium uranyl peruranate, $(NH_4)_2(UO_2)UO_8+8H_2O$ (?).

Easily sol. in H_2O. (Fairley, Chem. Soc. (2) **31.** 134.)

Potassium peruranate, $K_4UO_8+10H_2O$ (?).

Unstable. (Fairley.)

Silver peruranate, $Ag_2U_2O_{11}$ (?).

(Guyard, Bull. Soc. (2) **1.** 95.)

Does not exist. (Alibegoff, A. **233.** 117.)

Sodium peruranate, $Na_4UO_8+8H_2O$.

Sol. in H_2O. Sl. sol. in alcohol. (Fairley.)

Sodium uranyl peruranate, $Na_2(UO_2)UO_8+6H_2O$ (?).

Sol. in H_2O. (Fairley.)

Philippium, Ph (?).

(Delafontaine, C. R. **87.** 559.)

Consists of terbium and yttrium. (Roscoe, B. **15.** 1274.)

Phosgene, $COCl_2$.

See **Carbonyl chloride.**

Phosphame, PN_2H (?).

Insol. in H_2O. Insol. in dil. HNO_3+Aq; gradually decomp. by conc. HNO_3. (Rose, Pogg. **24.** 308.)

Insol. in conc. HNO_3. (Pauli, A. **123.** 236.)

Sol. in H_2SO_4 with decomp. (Rose.)

Insol. in dil., but decomp. by conc. KOH or $NaOH+Aq$.

Insol. in alcohol or ether.

Formula is perhaps $P_3N_3H_4$. (Salzmann, B. **6.** 494.)

Phosphamic acid, $PO\genfrac{}{}{0pt}{}{\diagup\!\!\!\diagup NH}{\diagdown OH}$.

(Schiff.)

Does not exist, but was impure *pyro*phospho*di*amic acid. (Gladstone.) Also Mente (A. **248.** 245).

*Pyro*phosphamic acid, $P_2NH_5O_6=P_2O_3(OH)_3NH_2$.

Deliquescent in moist air; easily sol. in H_2O or alcohol; sl. sol. in ether. (Gladstone, Chem. Soc. **3.** 152.)

Correct composition is imido*di*phosphoric acid, $P_2NH_4O_5=HO{-}PO{<}\genfrac{}{}{0pt}{}{O}{NH}{>}PO{-}OH$.

(Mente, A. **248.** 232.)

Barium *pyro*phosphamate, $Ba_3(P_2NH_2O_6)_2$.

Sol. in HCl or HNO_3+Aq, not in $HC_2H_3O_2+Aq$. (Gladstone and Holmes, Chem. Soc. (2) **2.** 233.)

Cupric *pyro*phosphamate, $Cu_3(P_2NH_2O_6)_2+2H_2O$.

Ppt. Decomp. by cold $KOH+Aq$. (Gladstone, Chem. Soc. **3.** 135.)

Ferric ——, $Fe_2(P_2NH_2O_6)_2+2H_2O$.

Insol. in dil. acids. Sol. in conc. H_2SO_4, and decomp. by warming. Easily sol. in NH_4OH+Aq. Decomp. by $KOH+Aq$. (Gladstone, Chem. Soc. **3.** 142.)

Lead ——, $Pb_3(P_2NH_2O_6)_2+4H_2O$.

Insol. in NH_4OH+Aq.

Potassium ——, $K_3P_2NH_2O_6$.

Deliquescent. Sol. in H_2O. Insol. in alcohol. (Gladstone, A. **76.** 85.)

Silver ——, $Ag_3P_2NH_2O_6+5H_2O$.

Ppt.

Zinc ——, $Zn_3(P_2NH_2O_6)_2$.

(Gladstone and Holmes, Chem. Soc. (2) **2.** 225.)

Phosphamide, PON.

See **Phosphoryl nitride.**

PN_2H_3O.

See **Phosphoryl imidoamide.**

***Tri*phosphamide,** PON_3H_6.

See **Phosphoryl *tri*amide.**

Phosphine.

See **Hydrogen phosphide.**

*Pyro*phospho*di*amic acid, $P_2N_2H_6O_5=P_2O_3(OH)_2(NH_2)_2$.

Deliquescent. Easily sol. in H_2O, alcohol, or ether. Sol. in cold conc. H_2SO_4 without decomp. (Gladstone, Chem. Soc. **3.** 353.)

Correct composition is *di*imido*di*phosphoric acid, $P_2N_2H_4O_4+H_2O=HO{-}PO{=}(NH)_2{=}PO{-}OH$. (Mente.)

Aluminum *pyro*phospho*di*amate.

Precipitate. Sol. in NH_4OH+Aq. Insol. in acids. (Gladstone, A. **76.** 82.)

Ammonium ——, $P_2O_3\genfrac{}{}{0pt}{}{(ONH_4)_2}{(NH_2)_2}$.

Very deliquescent in moist air. Sol. in H_2O. (Schiff, A. **103.** 168.)

Barium ——, $BaP_2O_5(NH_2)_2$.

Precipitate. Sl. sol. in H_2O. Sol. in NH_4OH+Aq. (Gladstone.)

Calcium ——, $CaP_2O_5(NH_2)_2$.

Insol. in NH_4OH+Aq. Sol. in NH_4Cl+Aq and acids. (Gladstone and Holmes.)

Lead ——.

Ppt. Decomp. by H_2O.

Magnesium ——.

Ppt. (Gladstone and Holmes.)

Silver ——, $Ag_2P_2O_5(NH_2)_2$.

Sl. sol. in H_2O. Sol. in HNO_3+Aq. (Gladstone and Holmes.)

Strontium ——.

Sol. in acids and NH_4Cl+Aq. Insol. in

NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4**. 295.)

Zinc *pyro***phospho***di***amate**, $ZnP_2O_5(NH_2)_2$.
Ppt. (Gladstone and Holmes.)

***Pyro*phospho*tri*amic acid,** $P_2N_3H_7O_4=P_2O_3{}^{OH}_{(NH_2)_3}$.

Decomp. by boiling H_2O or HCl. Sol. in conc. H_2SO_4 upon heating. (Gladstone and Holmes.)

Correct formula is $HO{-}PO{<}{}^{NH}_{NH}{>}PO{-}NH_2$ =*di*imido*di*phospho*mon*amic acid. (Mente, A. **248**. 241.)

Ammonium *pyro***phospho***tri***amate**, $P_2O_3{}^{ONH_4}_{(NH_2)_3}$.
Insol. in H_2O. (Gladstone and Holmes.)

Barium ——, $BaP_2N_3H_5O_4$.
$BaH_2(P_2N_3H_5O_4)_2$. Decomp. by $HCl+Aq$. (Gladstone, Chem. Soc. **4**. 6.)

Cobaltous ——, $CoP_2N_3H_5O_4$.
Slowly decomp. by dil. H_2SO_4+Aq, not by $HCl+Aq$. (Gladstone and Holmes, Chem. Soc. (2) **4**. 1.)

Cupric ——, $CuP_2N_3H_5O_4$.
Insol. in H_2O or NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4**. 1.)

Ferrous ——, $FeH_6(P_2N_3H_3O_4)_2$.
Insol. in dil. acids. (Gladstone, Chem. Soc. (2) **4**. 1.)

Lead ——, $H_2Pb_3(P_2N_3H_3O_4)_2$.
Ppt. (Gladstone and Holmes, Chem. Soc. (2) **4**. 1.)
$H_4Pb_2(P_2N_3H_3O_4)_2$. Ppt. (G. and H.)
$H_6Pb(P_2N_3H_3O_4)_2$. (G. and H.)

Mercuric ——, $Hg_2P_2N_3H_3O_4$.
Insol. in H_2O or dil. HCl or HNO_3+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4**. 1.)

Platinum ——, $Pt_2P_2N_3H_3O_4$.
Decomp. by H_2O when freshly pptd. (G. and H.)

Potassium ——, $KP_2N_3H_6O_4$.
Almost insol. in H_2O. (Gladstone, Chem. Soc. **4**. 10.)

Silver ——, $Ag_3P_2N_3H_4O_4$.
Ppt. Sl. attacked by $HC_2H_3O_2$; decomp. by HNO_3 or NH_4OH+Aq into—
$AgH_2P_2N_3H_4O_4$. Insol. in H_2O. Decomp. by HCl. (Gladstone, Chem. Soc. (2) **4**. 1.)

Zinc ——.
Insol. in H_2O. (Gladstone and Holmes.)

***Tetra*phospho*di*amic acid,** $P_4N_2H_8O_{11}=P_4O_7{}^{(OH)_4}_{(NH_2)_2}$.
Known only as NH_4 salt.

Ammonium *tetra***phospho***di***amate**, $P_4O_7{}^{O_4H(NH_4)_3}_{(NH_2)_2}$.
Very deliquescent, and sol. in H_2O. (Gladstone.)

Ammonium *di***hydrogen** *tetra***phospho***di***amate**, $P_4N_4H_{16}O_{12}=P_4O_7{}^{O_4H_2(NH_4)_2}_{(NH_2)_2}$ (?).
Insol. in cold, easily sol. in hot H_2O and dil. acids. (Gladstone.)

***Tetra*phospho*tetr*amic acid,** $P_4N_4H_{10}O_9=P_4O_7{}^{(OH)_2}_{(NH_2)_4}$.
Sol. in H_2O. Insol. in alcohol. (Gladstone.)

Ammonium *tetra***phospho***tetr***amate**, $P_4O_7{}^{(O_2HNH_4)}_{(NH_2)_4}$.
Sol. in H_2O, and precipitated from solution by alcohol. (Gladstone.)

Silver ——, $Ag_6P_4N_4H_4O_9$.
Ppt.
$Ag_2H_4P_4N_4H_4O_9$. Ppt.

***Tetra*phospho*pent*azotic acid,** $P_4N_5H_9O_7=P_4O_7{}^{(NH_2)_4}_{NH}$.
Insol. in H_2O. Decomp. gradually by boiling with H_2O. (Gladstone.)

Ammonio*tetra***phospho***pent***azotic acid** (?), $P_4O_7{}^{(NH_2)_4}_{NH.NH_3}$.
Decomp. by H_2O. (Gladstone.)

Cupric *tetra***phospho***pent***azotate.**
(Gladstone, Chem. Soc. (2) **6**. 261.)

Lead ——.
(Gladstone, Chem. Soc. (2) **6**. 261.)

Potassium ——, $KOP_4N_5H_8O_6$.
Insol. in H_2O. (Gladstone, Chem. Soc. (2) **6**. 268.)

Phosphoboric acid, H_3BO_3, $H_3PO_4=BPO_4+3H_2O$.
Not decomp. by boiling H_2O or conc. acids. Sol. in boiling solution of caustic alkalies. (Vogel, N. Repert. Pharm. **18**. 611.)

Phosphochloroplatinous acid, $P(OH)_3$, $PtCl_2$.
See **Chloroplatinophosphoric acid.**

Phosphohypophosphotungstic acid.

Potassium sodium phosphohypophosphotungstate, $9K_2O$, Na_2O, $4P_2O_5$, $2PO_2H_3$, $26WO_3+23H_2O$.
Precipitate. Easily sol. in hot H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

***Tetra*phospho*tetr*imidic acid,** $P_4N_4H_6O_7=P_4O_7{}^{(NH_2)_2}_{(NH)_2}$.
Known only in its salts. (Gladstone.)

Silver *tetra***phospho***tetr***imidate.**
Ppt. (Gladstone.)

Phosphoiridic acid.
See **Chlorophosphoiridic acid.**

Phospholuteotungstic acid, $H_5PW_8O_{29}$.
See under **Phosphotungstic acid.**

Phosphomolybdic acid, $3H_2O$, P_2O_5, $20MoO_3$.

$+21H_2O$. Very sol. in H_2O. Sol. in ether. By evaporation of H_2O solution crystals with $44H_2O$, or from a strong solution in conc. HNO_3+Aq with $19H_2O$, are obtained; also crystals with 38, and $48H_2O$ are known. (Debray, C. R. **66.** 704.)

According to Rammelsberg (B. **10.** 1776) formula is $3H_2O$, P_2O_5, $22MoO_3$.

According to Gibbs (Am. Ch. J. **3.** 317) formula is $3H_2O$, P_2O_5, $24MoO_3+59H_2O$.

Finkener (B. **11.** 1638) gives the formula as $3H_2O$, P_2O_5, $24MoO_3+58H_2O$, also with $29H_2O$.

P_2O_5, $20MoO_3+52H_2O$. Sol. in dry ether with evolution of heat, and subsequent separation into two layers, the upper consisting of pure ether, and lower of a solution of acid in ether. Sp. gr. of lower layer, when sat. at 13°, is 1·3. On warming lower layer, ether separates out and forms an upper layer. This redissolves on cooling and shaking. The lower layer is insol. in H_2O and miscible with alcohol.

100 pts. ether thus dissolve 80·6 pts. acid at 0°; 84·7 pts. at 8·1°; 96·7 pts. at 19·3°; 103·9 pts. at 27·4°; 107·9 pts. at 32·9°. (Parmentier, C. R. **104.** 688.)

*Di***phospho***penta***molybdic acid,**
$H_6P_2Mo_5O_{23}=3H_2O$, P_2O_5, $5MoO_3$.

Not known in free state.

Ammonium phosphomolybdate, $(NH_4)_3PO_4$, $11MoO_3+6H_2O$.

Formula is $(NH_4)_3PO_4$, $10MoO_3+1\frac{1}{2}H_2O$, according to the older authorities.

Scarcely sol. in H_2O or aqueous acid solutions. Easily sol. in ammonia, and alkalies + Aq. (Svanberg and Struve, J. pr. **44.** 291.)

It is almost completely insol. in a mixture of $(NH_4)_2MoO_4+Aq$, and dil. HNO_3+Aq. Absolutely insol. in a dil. nitric acid solution of ammonium nitrate. (Richters, Z. anal. **10.** 471.)

Solubility is increased even in presence of ammonium molybdate and free HNO_3 by HCl, ammonium, and other chlorides, tartaric acid, or large quantities of ammonium oxalate or citrate. Not precipitated in presence of excess of H_3PO_4. (Fresenius, Z. anal. **3.** 446.)

Sol. in 10,000 pts. H_2O at 16°; in 6600 pts. H_2O containing 1 vol. % HNO_3; in 550 pts. $HCl+Aq$ of 1·12 sp. gr.; in 620 pts. alcohol of 0·80 sp. gr.; in 190 pts. HNO_3+Aq (sp. gr. = 1·2) at 50°; in 5 pts. conc. H_2SO_4 at 100°; in 3 pts. NH_4OH+Aq of 0·95 sp. gr. (Eggertz, J. pr. **79.** 496.)

Sol. in 21,186 pts. H_2O, 38,117 pts. dil. alcohol, and 13,513 pts. strong alcohol. (Hehner, Analyst, **1879.** 23.)

According to Sonnenschein, the solubility is increased by much H_2O or alcohol, alkaline hydroxides, carbonates, ortho-, pyro-, and metaphosphates; sodium borate, hyposulphate, thiosulphate, acetate, arsenate, and arsenite; potassium sodium tartrate, ammonium oxalate, orthophosphoric acid, and sulphuric acid. It is not increased by ammonium molybdate or sulphate, potassium sulphate, acid tartrate, acid oxalate, nitrate, or chlorate, iodide, chloride, or bromide; sodium bromide or nitrate; nitric, hydrochloric, boric, tartaric, oxalic, and dilute sulphuric acids. (Sonnenschein, J. pr. **53.** 342.)

Sol. in hot H_2O. Sol. in cold caustic alkalies, alkali carbonates, and phosphates, NH_4Cl, and $(NH_4)_2C_2O_4+Aq$; sl. sol. in $(NH_4)_2SO_4$, KNO_3, and $KCl+Aq$; very sl. sol. in NH_4NO_3+Aq. Sol. in K_2SO_4, Na_2SO_4, NaCl, $MgCl_2$, H_2SO_4, HCl, and conc. or dil. HNO_3+Aq.

Presence of $(NH_4)_2MoO_4$ totally changes the effect of acid liquids; insol. in dil. HNO_3 or H_2SO_4+Aq containing $(NH_4)_2MoO_4$, but somewhat sol. in $HCl+Aq$, even in presence of that salt. Tartaric acid and similar organic substances totally prevent the precipitation of this salt. (Eggertz in Fresenius' Quant. anal.)

$5(NH_4)_2O$, $48MoO_3$, $2P_2O_5+17H_2O=3(NH_4)_2O$, $24MoO_3$, $P_2O_5+2(NH_4)_2O$, H_2O, $24MoO_3$, $P_2O_5+16H_2O$. Formula of above salt according to Gibbs.

$3(NH_4)_2O$, $22MoO_3$, $P_2O_5+9H_2O$, or $12H_2O$.

$8(NH_4)_2O$, H_2O, $60MoO_3$, $3P_2O_5+11H_2O$. Sl. sol. in H_2O.

$3(NH_4)_2O$, $16MoO_3$, $P_2O_5+14H_2O$. Insol. in cold, sol. with decomp. in hot H_2O. Sol. in NH_4OH+Aq. (Gibbs, Am. Ch. J. **3. 317.**)

Ammonium *di***phospho***penta***molybdate,**
$2(NH_4)_3PO_4$, $5MoO_3+7H_2O=3(NH_4)_2O$, $5MoO_3$, $P_2O_5+7H_2O$.

Easily sol. in hot, less in cold H_2O. (Zenkner, J. pr. **58.** 256.)

$5(NH_4)_2O$, H_2O, $10MoO_3$, $2P_2O_5+6H_2O=3(NH_4)_2O$, $5MoO_3$, $P_2O_5+2(NH_4)_2O$, H_2O, $5MoO_3$, $P_2O_5+6H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J.)

Ammonium barium phosphomolybdate,
$3(NH_4)_2O$, $30BaO$, P_2O_5, $30MoO_3$.

Insol. precipitate. (Seligsohn, J. pr. **67.** 478.)

Ammonium potassium phosphomolybdate,
$6(NH_4)_2O$, $15K_2O$, $2P_2O_5$, $60MoO_3+12H_2O$.

Sol. in H_2O. Insol. in alcohol. (Seligsohn, J. pr. **67.** 477.)

Ammonium sodium phosphomolybdate,
$6(NH_4)_2O$, $15Na_2O$, $2P_2O_5$, $60MoO_3+18H_2O$.

Sol. in much boiling H_2O. Insol. in alcohol. (Seligsohn, J. pr. **67.** 474.)

Croceocobaltic phosphomolybdate, $24MoO_3$, P_2O_5, $[Co(NH_3)_4(NO_2)_2]_2O$, $2H_2O+21H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 317.)

Lead phosphomolybdate, $23PbMoO_4$, P_2O_5, $2PbPO_4+7H_2O$.

Sol. in 500,000 pts. H_2O. Insol. in NH_4OH+Aq. Easily sol. in KOH, NaOH, or HNO_3+Aq; somewhat less sol. in $HC_2H_3O_2$+Aq. (Beuf, Bull. Soc. (3) **3.** 852.)

Potassium phosphomolybdate, $K_3PO_4, 11MoO_3 + 1\frac{1}{2}H_2O = 3K_2O, P_2O_5, 22MoO_3 + 3H_2O$.

Insol. in H_2O. Easily sol. in alkalies. (Svanberg and Struve.)

According to older authorities the formula is $K_3PO_4, 10MoO_3 + 1\frac{1}{2}H_2O$.

$+6H_2O$. (Rammelsberg.)

$2K_2O, H_2O, 24MoO_3, P_2O_5 + 3H_2O$. Sl. sol. in cold H_2O.

$5K_2O, H_2O, 44MoO_3, 2P_2O_3 + 21H_2O$. (Gibbs, Am. Ch. J. **3.** 317.)

$4K_2O, 2H_2O, 9MoO_3, P_2O_5 + 18H_2O$. (Zenkner.)

$5K_2O, H_2O, 10MoO_3, P_2O_5 + 19H_2O$. Easily sol. in H_2O. (Rammelsberg, B. **10.** 1776.)

$6K_2O, 15MoO_3, P_2O_5$. Insol. in H_2O. Sol. in KOH+Aq. (Rammelsberg.)

$K_2O, P_2O_5, 2MoO_3 + 13H_2O$. Very sol. in H_2O. (Friedheim, Z. anorg. **4.** 287.)

$2K_2O, P_2O_5, 4MoO_3 + 8H_2O$. Sol. in H_2O. (Friedheim.)

Potassium *di*phospho*penta*molybdate, $3K_2O, P_2O_5, 5MoO_3 + 7H_2O$.

Sol. in H_2O; precipitated by HNO_3 or HCl+Aq. (Zenkner, J. pr. **58.** 261.)

$2K_2O, P_2O_5, 5MoO_3 + 6H_2O$. (Friedheim.)

Potassium *di*phospho*penta*molybdate nitrate, $2K_3PO_4, 5MoO_3, 6KNO_3 + 9H_2O$.

(Debray, C. R. **66.** 706.)

Silver phosphomolybdate, $7Ag_2O, P_2O_5, 20MoO_3 + 24H_2O$.

Ppt. Sol. in dil. HNO_3+Aq, forming—

$2Ag_2O, P_2O_5, 20MoO_3 + 7H_2O$. Sl. sol. in H_2O. (Rammelsberg.)

Formula of first salt is—

$7Ag_2O, 22MoO_3, P_2O_5 + 14H_2O$. Sol. in hot H_2O, but solution is quickly decomp. (Gibbs, Am. Ch. J. **3.** 317.)

Silver *di*phospho*penta*molybdate, $Ag_6Mo_5P_2O_{23} + 7H_2O$.

Easily sol. in H_2O. (Debray, C. R. **66.** 705.)

Sodium phosphomolybdate.

Sol. in H_2O and HNO_3+Aq. (Sonnenschein, A. **104.** 45.)

$Na_2O, 5H_2O, P_2O_5, 18MoO_3 + xH_2O$.
$2Na_2O, 4H_2O, P_2O_5, 18MoO_3 + xH_2O$.
$3Na_2O, P_2O_5, 18MoO_3 + 26H_2O$. (Friedheim.)

Sodium *di*phospho*penta*molybdate, $3Na_2O, P_2O_5, 5MoO_3 + 14H_2O$.

Easily sol. in H_2O. (Debray.)

*Meta*phosphomolybdic acid.

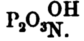
Ammonium *monometa*phosphomolybdate, $3(NH_4)_2O, 4NH_4PO_3, 10MoO_3 + 9H_2O$.

Very sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Barium *hexameta*phosphomolybdate, $BaO, Ba_3(PO_3)_6, 14MoO_3 + 55H_2O$.

Sol. in H_2O. (Gibbs.)

*Pyro*phosphonitrylic acid, P_2NHO_4 =


$P_2O_3\begin{matrix}OH\\N\end{matrix}$.

Not known in free state.

Ammonium *pyro*phosphonitrylate,

$P_2O_3\begin{matrix}ONH_4\\N\end{matrix}$.

Insol. but gradually decomp. by H_2O. (Gladstone.)

Potassium ——, KP_2NO_4.

Insol. in H_2O. (Gladstone.)

Silver ——, AgP_2NO_4.

Ppt.

Phosphonium bromide, PH_4Br.

Decomp. violently by H_2O.

Phosphonium chloride, PH_4Cl.

(Ogier, Bull. Soc. (2) **32.** 483.)

Phosphonium titanium chloride, $2PH_4Cl, 3TiCl_4$.

Decomp. by H_2O, HCl, or alkalies +Aq. (Rose.)

Phosphonium iodide, PH_4I.

Decomp. by H_2O, alkalies, alcohol, etc (Rose, Pogg. **46.** 636.)

Decomp. by PCl_3. (Wilde, B. **16.** 217.)

Phosphonium sulphate (?).

Deliquescent; very unstable. (Besson, C. R. **109.** 644.)

Phosphor*tri*amide, PON_3H_6.

See **Phosphoryl *tri*amide.**

Phosphoric acid, *anhydrous*, P_2O_5.

See **Phosphorus *pent*oxide.**

*Meta*phosphoric acid, HPO_3.

Sol. in H_2O. Not isolated. (Fleitmann, Pogg. **78.** 362.)

*Dimeta*phosphoric acid, $H_2P_2O_6$.

Not isolated. (Fleitmann.)

*Trimeta*phosphoric acid, $H_3P_3O_9$.

Sol. in H_2O; the solution is permanent in the cold, but on evaporation it is quickly decomp. to H_3PO_4.

*Tetrameta*phosphoric acid, $H_4P_4O_{12}$.

Not isolated.

*Hexameta*phosphoric acid, $H_6P_6O_{18}$. (Glacial phosphoric acid.)

Deliquescent; easily sol. in H_2O with evolution of heat and conversion into H_3PO_4. . Not easily sol. in presence of slight impurities.

*Ortho*phosphoric acid, H_3PO_4.

Very sol. in H_2O.

Sp. gr. of H_3PO_4+Aq containing:

10	20	30	40	50	; P_2O_5.
1·1	1·23	1·39	1·6	1·85	

(Dalton.)

Sp. gr. of H_3PO_4+Aq.

Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5
1·508	49·60	1·328	36·15	1·144	17·89
1·492	48·41	1·315	34·82	1·136	16·95
1·476	47·10	1·302	33·49	1·124	15·64
1·464	45·63	1·293	32·71	1·113	14·33
1·453	45·38	1·285	31·94	1·109	13·25
1·442	44·13	1·276	31·03	1·095	12·18
1·434	43·95	1·268	30·13	1·081	10·44
1·426	43·28	1·257	29·16	1·073	9·53
1·418	42·61	1·247	28·24	1·066	8·62
1·401	41·60	1·236	27·30	1·056	7·39
1·392	40·86	1·226	26·36	1·047	6·17
1·384	40·12	1·211	24·79	1·031	4·15
1·376	39·66	1·197	23·23	1·022	3·03
1·369	39·21	1·185	22·07	1·014	1·91
1·356	38·00	1·173	20·91	1·006	0·79
1·347	37·37	1·162	19·73	...	...
1·339	36·74	1·153	18·81	...	...

(Watts, C. N. **12.** 160.)

Specific gravity of H_3PO_4+Aq containing:

6	12	18	% H_3PO_4,
1·0333	1·0688	1·1065	

24	36	54	% H_3PO_4.
1·1463	1·2338	1·3840	

(Schiff, A. **113.** 183.)

Sp. gr. of H_3PO_4+Aq at 15°. a=sp. gr. if % is P_2O_5; b=sp. gr. if % is H_3PO_4.

%	a	b	%	a	b
1	1·009	1·0054	31	1·288	1·1962
2	1·017	1·0109	32	1·299	1·2036
3	1·025	1·0164	33	1·310	1·2111
4	1·032	1·0220	34	1·321	1·2186
5	1·039	1·0276	35	1·333	1·2262
6	1·047	1·0333	36	1·345	1·2338
7	1·055	1·0390	37	1·357	1·2415
8	1·063	1·0449	38	1·369	1·2493
9	1·071	1·0508	39	1·381	1·2572
10	1·080	1·0567	40	1·393	1·2651
11	1·089	1·0627	41	1·407	1·2731
12	1·098	1·0688	42	1·420	1·2812
13	1·106	1·0749	43	1·432	1·2894
14	1·115	1·0811	44	1·445	1·2976
15	1·124	1·0874	45	...	1·3059
16	1·133	1·0937	46	...	1·3143
17	1·142	1·1001	47	...	1·3227
18	1·151	1·1065	48	...	1·3313
19	1·161	1·1130	49	...	1·3399
20	1·171	1·1196	50	...	1·3486
21	1·182	1·1262	51	...	1·3573
22	1·192	1·1329	52	...	1·3661
23	1·202	1·1397	53	...	1·3750
24	1·212	1·1465	54	...	1·3840
25	1·223	1·1534	55	...	1·3931
26	1·233	1·1604	56	...	1·4022
27	1·244	1·1674	57	...	1·4114
28	1·254	1·1745	58	...	1·4207
29	1·265	1·1817	59	...	1·4301
30	1·277	1·1889	60	...	1·4395

(Schiff, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of H_3PO_4+Aq at 17·5°.

% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.
1	1·007	24	1·208	47	1·476
2	1·014	25	1·219	48	1·491
3	1·021	26	1·229	49	1·505
4	1·028	27	1·240	50	1·521
5	1·036	28	1·250	51	1·536
6	1·044	29	1·261	52	1·551
7	1·053	30	1·272	53	1·566
8	1·061	31	1·282	54	1·581
9	1·070	32	1·293	55	1·597
10	1·078	33	1·304	56	1·613
11	1·086	34	1·315	57	1·629
12	1·095	35	1·326	58	1·645
13	1·103	36	1·338	59	1·661
14	1·112	37	1·350	60	1·677
15	1·120	38	1·362	61	1·693
16	1·129	39	1·374	62	1·709
17	1·139	40	1·386	63	1·725
18	1·148	41	1·398	64	1·741
19	1·158	42	1·410	65	1·758
20	1·168	43	1·423	66	1·775
21	1·178	44	1·436	67	1·792
22	1·188	45	1·448	68	1·809
23	1·198	46	1·462	...	...

(Hager, Adjumenta varia, Leipzig, **1876.**)

Table for correction to be added or subtracted for 1° change in temperature.

% P_2O_5	Corr.	% P_2O_5	Corr.
10-14	0·00035	36-45	0·00068
15-25	0·0004	46-55	0·00082
26-35	0·00052	56-68	0·001

(Hager.)

Miscible with conc. $HC_2H_3O_2$+Aq. Sol. in 30 pts. warm creosote.

*Pyro*phosphoric acid (*Di*phosphoric acid), $H_4P_2O_7$.

Very sol. in H_2O. The solution may be kept without change, but on heating it is converted into H_3PO_4.

Phosphoric acid, $H_8P_2O_9$ (?).

Sol. in H_2O. (Joly, C. R. **100.** 447.)

Phosphates.

The phosphates of NH_4, K, Na, Li, Cs, and Rb are sol. in H_2O, with the exception of certain metaphosphates; the other phosphates, excepting neutral Tl salts, are nearly insol. in H_2O, excepting when an excess of H_3PO_4 is present. The latter are all sol. in HNO_3+Aq.

(*α*) **Metaphosphates.**

*Mono***metaphosphates.** Only alkali monometaphosphates are known, and they are all insol. in H_2O.

*Di***metaphosphates.** Alkali dimetaphosphates and some double salts containing an alkali as one of the bases are sol. in H_2O, the rest are sl. sol. or insol. in H_2O.

***Tri*metaphosphates.** All salts are sol. in H_2O.

***Tetra*metaphosphates.** The alkali salts are sol. in H_2O, the others are insol.

***Hexa*metaphosphates.** The alkali salts are sol., the others insol., in H_2O, but are mostly sol. in Na hexametaphosphate + Aq.

(*b*) **Orthophosphates.** K, Na, Li, Cs, and Rb orthophosphates are sol. in H_2O. All the others are insol. in H_2O, but sol. in excess of H_3PO_4, and HNO_3 + Aq; less easily sol. in $HC_2H_3O_2$ + Aq. Pb, Al, and Fe_2 phosphates are insol. in $HC_2H_3O_2$ + Aq. Sl. sol. in NH_4 salts + Aq, especially NH_4Cl + Aq, from which solution they are pptd. by NH_4OH + Aq. Orthophosphates insol. in H_2O are also insol. in an excess of alkali orthophosphates + Aq.

All orthophosphates are insol., or very sl. sol. in alcohol.

(*c*) **Pyrophosphates.** Alkali pyrophosphates are sol. in H_2O; the others are insol. in H_2O, but are mostly sol. in an excess of Na pyrophosphate + Aq.

Aluminum *meta*phosphate, $Al_2(PO_3)_6$.

Insol. in H_2O and conc. acids. (Maddrell, A. **61**. 59.)

Aluminum *ortho*phosphate, basic, $3Al_2O_3, P_2O_5+18H_2O$.

Min. *Evansite.*

$4Al_2O_3, 3P_2O_5+18H_2O$. Ppt. Insol. in H_2O. (Rammelsberg.)

$2Al_2O_3, P_2O_5$.

$+3H_2O$. Min. *Angelite.*

$+5H_2O$. Min. *Kalaite* (*Turquoise*). Sol. in HCl + Aq.

$+6H_2O$. Decomp. by H_2O. (Hautefeuille, J. pr. (2) **37**. 111.)

Min. *Peganite.* More or less sol. in HCl, and HNO_3 + Aq.

$+8H_2O$. Ppt. (Munroe, A. **159**. 278.)

Min. *Fischerite.* Sl. attacked by HCl or HNO_3 + Aq; sol. in H_2SO_4 + Aq.

$3Al_2O_3, 2P_2O_5+8H_2O$, or $12H_2O$. Sol. in acids, even after ignition. (Millot, C. R. **82**. 89.)

$+10H_2O$. Min. *Cœruleolactite.* Sol. in acids.

$+12H_2O$. Min. *Wavellite.*

Aluminum *ortho*phosphate, $Al_2(PO_4)_2$.

Crystalline. Not attacked by conc. HCl or HNO_3 + Aq, difficultly by hot conc. H_2SO_4. (de Schulten, C. R. **98**. 1583.)

$+4H_2O$. Easily sol. in mineral acids, insol. in acetic and other organic acids. Easily sol. in KOH + Aq, but is reprecipitated by NH_4Cl + Aq. Sol. in NH_4OH + Aq. Sol. in a large amount of alum + Aq (Rose), in aluminum acetate and other aluminum salts + Aq (Fleischer, Z. anal. **6**. 28). More sol. than ferric phosphate in ammonium oxalate or citrate + Aq. (Millot.)

Acid NH_4 citrate + Aq dissolves 3 % of the P_2O_5; neutral NH_4 citrate + Aq dissolves 6·6 % of the P_2O_5; ammoniacal NH_4 citrate + Aq dissolves completely in 25 min. (Erlenmeyer, B. **14**. 1869.)

Sol. in NH_4OH + Aq, especially in presence of alkali phosphates. (de Koninck, Z. anal. **23**. 90.)

Not pptd. in presence of alkali tartrates or citrates, sugar, glycerine, etc.

Min. *Variscite.* Very quickly sol. in warm conc. HCl + Aq.

$+5H_2O$. Min. *Zepharovitchite.*

$+8H_2O$. Min. *Gibbsite.*

Aluminum *ortho*phosphate, acid, $2Al_2O_3, 3P_2O_5+16H_2O$.

Insol. in acids after being ignited. (Millot, Bull. Soc. (2) **22**. 244.)

$+4H_2O$, and $6H_2O$. Insol. in H_2O or alcohol. (Hautefeuille and Margottet, J. pr. (2) **37**. 111.)

$Al_2O_3, 2P_2O_5+8H_2O$. Insol. in acids or aqua regia after being ignited. (Millot.)

$2Al_2O_3, 5P_2O_5+14H_2O$. Decomp. by cold H_2O into—

$4Al_2O_3, 7P_2O_5+9H_2O$. Decomp. by hot H_2O. (Erlenmeyer, A. **194**. 200.)

$Al_2O_3, 3P_2O_5+3H_2O=Al_2(H_2PO_4)_6$. Deliquescent; completely sol. in a little cold H_2O, and conc. solution can be boiled without decomp., but dil. solution (1 : 20) separates $Al_2(PO_4)_2$ on boiling, which redissolves on cooling, the more quickly the more dilute the original solution. (Erlenmeyer, A. **194**. 198.)

Aluminum *pyro*phosphate, $Al_4(P_2O_7)_3+10H_2O$.

Precipitate. Sol. in mineral acids, and $Na_4P_2O_7$ + Aq; insol. in acetic acid. Sol. in KOH + Aq; sol. in NH_4OH + Aq, but when dissolved in HCl + Aq is reprecipitated by NH_4OH + Aq, and is not redissolved in an excess thereof. (Schwarzenberg, A. **65**. 147.)

Sol. in alum + Aq. (Rose, Pogg. **76**. 19.)

Aluminum *pyrometa*phosphate, $Al_2O_3, 2P_2O_5$.

(Hautefeuille and Margottet, C. R. **96**. 849.)

Aluminum calcium phosphate, $Al_2O_3, 3CaO, P_2O_5+3H_2O$.

Min. *Tavistockite.*

$2Al_2O_3, 6CaO, 3P_2O_5+3H_2O$. Min. *Kirrolite.*

Aluminum calcium phosphate sulphate, $3Al_2O_3, SO_3, Ca_3(PO_4)_2+6H_2O$.

Min. *Svanbergite.* Scarcely attacked by HCl + Aq, and only sl. by H_2SO_4 + Aq.

Aluminum ferrous magnesium phosphate, $(Mg, Fe)_2Al_2P_2O_{10}+4H_2O$.

Min. *Childrenite.* Slowly sol. in HCl + Aq.

Min. *Eosphorite.* Sol. in HNO_3 or HCl + Aq.

$(Mg, Fe)Al_2P_2O_9+H_2O$. Min. *Lazulite.* Only sl. attacked by acids, when not previously ignited.

Aluminum lithium phosphate, $Al_2(PO_4)_2, 4Li_3PO_4+30H_2O$.

Precipitate. (Berzelius.)

Insol. in H_2O; easily sol. in acids.

Aluminum magnesium phosphate.

Min. *Lazulite.*

See **Phosphate, aluminum ferrous magnesium.**

Aluminum potassium phosphate, Al_2O_3, K_2O, $2P_2O_5$.

Insol. in acids. (Ouvrard, A. ch. (6) **16.** 289.)

$2Al_2O_3$, $2K_2O$, $3P_2O_5$. (Ouvrard.)

Aluminum silver *meta***phosphate,** $2Al_2O_3$, Ag_2O, $4P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 849, 1142.)

Aluminum sodium *pyro***phosphate,** $Al_2Na_2(P_2O_7)_2$.

Insol. in H_2O and acids. (Wallroth.)

Nearly insol. in acids. (Ouvrard, A. ch. (6) **16.** 338.)

$2Al_2O_3$, $3Na_2O$, $3P_2O_5$. Sol. in HNO_3+Aq. (Ouvrard.)

$Al_4(P_2O_7)_3$, $2Na_4P_2O_7+30H_2O$.

Very difficultly sol. in H_2O. (Pahl, Bull. Soc. (2) **22.** 122.)

Aluminum phosphate lithium fluoride, $2Al_2(PO_4)_2$, $3LiF$.

Min. *Amblygonite.* Sl. attacked by HCl+Aq, more easily by H_2SO_4+Aq.

Ammonium *meta***phosphate,** NH_4PO_3.

Insol. in H_2O. (Fleitmann, Pogg. **78.** 345.)

Ammonium *dimeta***phosphate,** $(NH_4)_2(PO_3)_2$.

Sol. in 1·15 pts. cold or hot H_2O. (Fleitmann, Pogg. **78.** 245.) More sol. in dil. alcohol than Na or K salt.

Ammonium *trimeta***phosphate,** $(NH_4)_3P_3O_9$.

Very sol. in H_2O. (Lindbom, Acta Lund. **1873.** 15.)

Ammonium *ortho***phosphate,** $(NH_4)_3PO_4+3H_2O$.

Difficultly sol. in H_2O.

Less sol. in H_2O than $(NH_4)_2HPO_4$. (Berzelius.)

Insol. in alkalies+Aq. (Berzelius.)

$+5H_2O$. (Sestini, Gazz. ch. it. **9.** 298.)

Ammonium hydrogen *ortho***phosphate,** $(NH_4)_2HPO_4$.

Easily sol. in H_2O. Effloresces to form $NH_4H_2PO_4$. (Schiff, A. **112.** 88.)

Sol. in 4 pts. cold, and less hot H_2O. Solution loses NH_3 by boiling. Insol. in alcohol.

Ammonium *di***hydrogen** *ortho***phosphate,** $NH_4H_2PO_4$.

Does not effloresce.

Less easily sol. in H_2O than $(NH_4)_2HPO_4$. (Mitscherlich, A. ch. **19.** 385.)

Sol. in 5 pts. cold, and less hot H_2O.

Ammonium *pyro***pnosphate,** $(NH_4)_4P_2O_7$.

Easily sol. in H_2O. Alcohol precipitates it from the aqueous solution. (Schwarzenberg, A. **65.** 141.)

Ammonium hydrogen *pyro***phosphate,** $(NH_4)_2H_2P_2O_7$.

Very sol. in H_2O. Insol. in alcohol. (Schwarzenberg, A. **65.** 141.)

Ammonium barium *trimeta***phosphate,** $(NH_4)BaP_3O_9+H_2O$.

Easily sol. in H_2O. (Lindbom.)

Ammonium cadmium *dimeta***phosphate,** $(NH_4)_2O$, CdO, $2P_2O_5+3H_2O=(NH_4)_2Cd(P_2O_6)_2$.

Efflorescent. (Fleitmann, Pogg. **78.** 347.)

Ammonium cadmium *ortho***phosphate,** $NH_4CdPO_4+1\frac{3}{4}H_2O$.

Easily sol. in NH_4OH+Aq and acids. (Drewson, Gm. K. Handb. 6^te^ Aufl. III. 74.)

Ammonium calcium *dimeta***phosphate,** $(NH_4)_2Ca(P_2O_6)_2+2H_2O$.

Very sl. sol. in H_2O. Not decomp. by acids. (Fleitmann, Pogg. **78.** 344.)

Ammonium calcium phosphate, $NH_4CaPO_4+xH_2O$.

Ppt. (Herzfeld and Feuerlein, Z. anal. **20.** 191.)

Ammonium cobaltous *meta***phosphate.**

Extremely sol. in H_2O and in NH_4OH+Aq. (Persoz, J. pr. **3.** 215.)

Ammonium cobaltous *ortho***phosphate,** $NH_4CoPO_4+H_2O$.

Not decomp. by boiling H_2O. (Debray, J. Pharm. (3) **46.** 121.)

$+12H_2O$. Ppt. (Chancel, **1862.**)

$Co(NH_4)_2H_2(PO_4)_2+4H_2O$. Insol. in H_2O. (Debray.)

Ammonium copper *dimeta***phosphate,** $(NH_4)_2P_2O_6$, $CuP_2O_6+2H_2O$.

Very sl. sol. in H_2O; insol. in alcohol. (Fleitmann, Pogg. **78.** 345.)

$+4H_2O$. Efflorescent. Very sl. sol. in H_2O; insol. in alcohol. (F.)

Ammonium glucinum *ortho***phosphate,** NH_4GlPO_4.

Insol. in cold, sl. sol. in hot H_2O. (Rössler, Z. anal. **17.** 148.)

Ammonium glucinum sodium *ortho***phosphate,** $(NH_4)_2GlNa_2(PO_4)_2+7H_2O$.

(Scheffer, A. **109.** 146.)

Ammonium ferrous *ortho***phosphate,** $NH_4FePO_4+H_2O$.

Insol. even in boiling H_2O. When still moist easily sol. in dil. acids, but sparingly and slowly sol. after drying, even in conc. acids. Decomp. by NH_4OH, KOH, and NaOH+Aq. Insol. in alcohol. (Otto, J. pr. **2.** 409.)

$(NH_4)_2FeH_2(PO_4)_2+4H_2O$. (Debray.)

Ammonium lead *dimeta***phosphate,** $(NH_4)_2Pb(P_2O_6)_2$.

Very difficultly sol. in H_2O and acids. (Fleitmann, Pogg. **78.** 343.)

Ammonium lithium phosphate, $(NH_4)_2LiPO_4$.

Sl. sol. in H_2O. (Berzelius.)

Ammonium magnesium *meta***phosphate,** $(NH_4)_2O$, $2MgO$, $2P_2O_5+9H_2O$ (?).

Sol. with difficulty in H_2O or acids when heated. Easily sol. in H_2O before heating. (Wach, Schw. J. **59.** 29.)

Precipitated from aqueous solution by alcohol.

Ammonium magnesium *dimeta*phosphate, $(NH_4)_2Mg(P_2O_6)_2 + 6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78.** 346.)

Ammonium magnesium phosphate, NH_4MgPO_4, and $+ 6H_2O$.

1 l. H_2O dissolves 66 mg. anhydrous NH_4MgPO_4 at 15°. (Fresenius, A. **55.** 109.)

1 l. H_2O dissolves 74·1 mg. anhydrous NH_4MgPO_4 at 20·5-22·5°. (Ebermayer.)

1 l. H_2O dissolves 106 mg. anhydrous NH_4MgPO_4. (Liebig.)

Aqueous solution is precipitated by NH_4OH, but not by Na_2HPO_4 + Aq. (Fresenius.)

Sol. in 14,600 pts. H_2O containing ammonia. More sol. in H_2O containing NH_4Cl, and is sol. in 7548 pts. of a solution containing 1 pt. NH_4Cl to 5 pts. H_2O and ammonia, and in 15,627 pts. of a solution containing 1 pt. of NH_4Cl to 7 pts. H_2O and ammonia. (Fresenius.)

According to Kremers (J. pr. **55.** 190), a solution of 3 pts. H_2O to 1 pt. NH_4OH + Aq of 0·96 sp. gr. is best suited for washing the precipitated NH_4MgPO_4.

According to Ebermayer (J. pr. **60.** 41), 1 pt. anhydrous salt is sol. in 13,497 pts. H_2O at 23°; in 31,098 pts. NH_4OH + Aq (4 pts. H_2O : 1 pt. NH_4OH + Aq of 0·961 sp. gr.) at 21·25°; in 36,764 pts. NH_4OH + Aq (3 pts. H_2O : 1 pt. NH_4OH + Aq) at 20·6°; in 43,089 pts. NH_4OH + Aq (1 pt. H_2O : 1 pt. NH_4OH + Aq) at 22·5°; in 45,206 pts. NH_4OH + Aq (1 pt. H_2O : 2 pts. NH_4OH + Aq) at 22·5°; in 52,412 pts. NH_4OH + Aq (1 pt. H_2O : 3 pts. NH_4OH + Aq) at 22·5°; in 60,883 pts. pure NH_4OH + Aq (sp. gr. 0·961) at 22·5°.

Almost absolutely insol. in H_2O containing ¼ vol. NH_4OH + Aq (sp. gr. 0·96) and NH_4Cl, *i.e.* much more insol. than given by Fresenius. (Kubel, Z. anal. **8.** 125.)

According to Kissel (Z. anal. **8.** 173), 1 l. NH_4OH + Aq (3 pts. H_2O : 1 pt. NH_4OH + Aq of 0·96 sp. gr.) dissolves 4·98 mg. in 24 hours, while 13·9 mg. are dissolved if 18 g. NH_4Cl to a litre of H_2O are also present.

$(NH_4)_2SO_4$ + Aq containing 2·2 g. per litre dissolves 71·7 mg.; 3·0 g., 113 mg.; 10 g., 147 mg.; NaCl + Aq containing 2 g. NaCl per l. dissolves 123·4 mg.; $NaNO_3$ + Aq containing 3 g. $NaNO_3$ per l. dissolves 93·1 mg. (Liebig, A. **106.** 196.)

Completely insol. in water containing ammonium phosphate or ammonium sodium phosphate. (Berzelius.)

800 ccm. H_2O, sat. with CO_2, dissolve 1·425 g. (Liebig.)

Easily sol. in H_2SO_3 + Aq, acetic and other acids, also in boiling solution of ammonium citrate. (Millot, Bull. Soc. (2) **18.** 20.)

When in presence of Fe or Al salts it is sol. to a considerable extent in $H_2C_4H_4O_6$ + Aq.

6 g. NH_4Cl in 100 ccm. H_2O containing 10 ccm. 6·34 % NH_4OH + Aq dissolve pptd. salt = 0·0029 g. $Mg_2P_2O_7$. 1 g. $(NH_4)_2C_2O_4$ in 100 ccm. H_2O, and NH_4OH + Aq dissolve = 0·0061 g. $Mg_2P_2O_7$. 2 g. citric acid in excess of NH_4OH + Aq dissolve = 0·0147 g. $Mg_2P_2O_7$. Solubility prevented by excess of magnesia mixture. (Lindo, C. N. **48.** 217.)

About 3 times as sol. in $Ca(C_2H_3O_2)_2$ + Aq as in $NaC_2H_3O_2$ + Aq, but solubility is prevented by excess of $MgCl_2$. (Ville, Bull. Soc. (2) **18.** 316.

Min. *Struvite*.

$+ H_2O$. Insol. in H_2O or citric acid + Aq. (Millot and Maquenne, Bull. Soc. (2) **23.** 238.)

Ammonium magnesium hydrogen *ortho*phosphate, $(NH_4)_2MgH_2(PO_4)_2 + 3H_2O$ (?).

(Graham.)

Ammonium magnesium phosphate, $5MgO, (NH_4)_2O, 2P_2O_5 + 24H_2O$.

(Gawalovsky, C. C. **1885.** 721.)

Ammonium manganous *dimeta*phosphate, $(NH_4)_2Mn(P_2O_6)_2 + 6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78.** 346.)

Ammonium manganous phosphate, $NH_4MnPO_4 + H_2O$.

Sol. in 32,092 pts. cold, and 20,122 pts. boiling H_2O, and in 17,755 pts. NH_4Cl + Aq (1·4 % NH_4Cl). (Fresenius.)

Easily sol. in dil. acids. Decomp. by KOH + Aq, but not by NH_4OH + Aq or K_2CO_3 + Aq. Insol. in NH_4OH or NH_4 salts + Aq. (Gibbs.)

Insol. in alcohol.

Ammonium manganous sodium *pyro*phosphate, $NH_4NaMnP_2O_7 + 3H_2O$.

Insol. in H_2O or alcohol. Easily sol. in very dil. acids. (Otto, J. pr. **2.** 418.)

Formula is $Na_4(NH_4)_4Mn_2(P_2O_7)_3 + 12H_2O$, according to Berzelius.

Ammonium mercuric *meta*phosphate.

Sol. in H_2O, or at least in NH_4OH + Aq. (Persoz, J. pr. **3.** 216.)

Ammonium nickel *meta*phosphate.

Insol. in H_2O. Sol. in NH_4OH + Aq, from which it is repptd. on evaporation of the NH_3. (Persoz, J. pr. **3.** 215.)

Ammonium nickel phosphate, $NH_4NiPO_4 + 2H_2O$.

Ppt. (Debray, C. R. **59.** 40.)

$+ 6H_2O$. Decomp. by boiling H_2O. (Debray.)

Ammonium potassium *dimeta*phosphate, $(NH_4)_{10}K_4(P_2O_6)_7$.

More sol. in H_2O than following salt. (Fleitmann, Pogg. **78.** 341.)

$NH_4K_3P_4O_{12} + 2H_2O$. Difficultly sol. in H_2O. (Fleitmann.)

Ammonium potassium *pyro*phosphate, $NH_4K_2HP_2O_7 + \frac{1}{2}H_2O$.

Deliquescent. Sol. in H_2O. Decomp. on boiling. (Schwarzenberg.)

Ammonium sodium *dimeta*phosphate, $NH_4NaP_2O_6+H_2O$.

More sol. in H_2O than $Na_2P_2O_6$, but less than $(NH_4)_2P_2O_6$. Less sol. in alcohol than in H_2O. (Fleitmann, Pogg. **78.** 340.)

Ammonium sodium phosphate, $(NH_4)_2NaPO_4+4H_2O$.

Decomp. by H_2O. Cryst. from NH_4OH+Aq of 0·96 sp. gr. From H_2O solution, $NaNH_4HPO_4+4H_2O$ separates out. (Uelsmann, Arch. Pharm. (2) **99.** 138.)

$+5H_2O$.

$NH_4Na_2PO_4+12H_2O$. (Herzfeld, Z. anal. **20.** 191.)

$(NH_4)_5Na(PO_4)_2+6H_2O$. Sol. in H_2O with decomp. Cryst. from hot conc. NH_4OH+Aq. (Uelsmann, Arch. Pharm. (2) **99.** 138.)

Ammonium sodium hydrogen phosphate (Microcosmic salt), $NH_4NaHPO_4+4H_2O$.

Efflorescent. Easily sol. in H_2O. Sol. in 6 pts. cold, and 1 pt. boiling H_2O. Insol. in alcohol.

Aqueous solution gives off NH_3, especially if hot.

Min. *Stercorite.*

$+5H_2O$. (Uelsmann.)

Ammonium sodium phosphate, $(NH_4)_3Na_3H_6(PO_4)_4+3H_2O$.

Decomp. by H_2O. (Filhol and Senderens, C. R. **93.** 388.)

Ammonium sodium *pyro*phosphate, $(NH_4)_2Na_2P_2O_7+5H_2O$.

Easily sol. in H_2O. Aqueous solution decomp. by boiling. (Schwarzenberg, A. **65.** 142.)

$+6H_2O$. (Rammelsberg.)

Ammonium sodium glucinum *ortho*phosphate, $(NH_4)_2Na_2Gl(PO_4)_2+7H_2O$.

Precipitate. (Scheffer.)

Ammonium thallous *ortho*phosphate, $(NH_4)_3PO_4$, $(NH_4)_2TlPO_4$, or $H_2NH_4PO_4$, HTl_2PO_4.

Sol. in H_2O. (Lamy; Rammelsberg.)

Ammonium uranyl phosphate, $NH_4(UO_2)PO_4+xH_2O$.

Insol. in H_2O and $HC_2H_3O_2+Aq$. Sol. in mineral acids, from which it is precipitated by $NH_4C_2H_3O_2+Aq$, in which it is insol. (Knop.)

Ammonium vanadium phosphate, $NH_4H(VO_2)PO_4$; $(NH_4)_2O$, V_2O_5, $2(VO_2)H_2PO_4+5H_2O$; and $2(NH_4)_2HPO_4$, $5(NH_4)_2O$, $12V_2O_5+25H_2O$.

See **Phosphovanadate, ammonium.**

Ammonium zinc *dimeta*phosphate, $(NH_4)_2Zn(P_2O_6)_2+6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78.** 347.)

Ammonium zinc *ortho*phosphate, $NH_4ZnPO_4+H_2O$.

Insol. in H_2O. Sol. in acids, and caustic alkalies. (Bette, A. **15.** 129.)

Ammonium zinc hydrogen phosphate, $NH_4H_2PO_4$, $ZnHPO_4+H_2O$.

Insol. in H_2O. (Debray.)

$4(NH_4)_2O$, $6ZnO$, $3P_2O_5$. (Schweikert, A. **145.** 57.)

$3(NH_4)_2O$, $4ZnO$, $2P_2O_5+13H_2O$. (Rother, A. **143.** 356.)

Barium *meta*phosphate, $Ba(PO_3)_2$.

Insol. in H_2O or dil. acids. (Maddrell, A. **61.** 61.)

Not decomp. by boiling with acids or alkali carbonates + Aq. (Fleitmann, Pogg. **78.** 352.)

Barium *dimeta*phosphate, $BaP_2O_6+2H_2O$.

More difficultly sol. in H_2O than $Ba_3(P_3O_9)_2$. Slightly attacked by boiling conc. $HCl+Aq$ or HNO_3+Aq. Easily decomp. by H_2SO_4. (Fleitmann, Pogg. **78.** 254.)

Barium *trimeta*phosphate, $Ba_3(P_3O_9)_2+2H_2O$.

Somewhat sol. in H_2O. (Fleitmann, A. **65.** 313.)

$+6H_2O$. Easily sol. in $HCl+Aq$. (Lindbom.)

Barium *hexameta*phosphate, $Ba_3P_6O_{18}$ (?).

Sol. in H_2O only after boiling several hours.

Nearly insol. in H_2O. (Lüdert, Z. anorg. **5.** 15.)

Insol. in NH_4Cl+Aq. (Wackenroder.)

Sol. in $Na_6P_6O_{18}+Aq$. Sol. in HNO_3+Aq. After ignition it is nearly insol in HNO_3+Aq.

Barium *ortho*phosphate, $Ba_3(PO_4)_2$.

Precipitate. Very sl. sol. or insol. in H_2O. (Graham, Pogg. **32.** 49.)

Sol. in $HCl+Aq$. Decomp. by SO_2+Aq.

Barium hydrogen phosphate, $BaHPO_4$.

Sol. in 10,000 pts. H_2O. (Malaguti, A. ch. (3) **51.** 346.)

Sol. in 20,570 pts. H_2O at 20°. (Bischof, **1833.**)

Not completely soluble in water containing CO_2, but $BaCl_2$ causes no ppt. in Na_2HPO_4+Aq containing 7·16 g. or less Na_2HPO_4 in a litre after it has been saturated with CO_2. (Setschenow, C. C. **1875.** 97.)

Easily sol. in H_3PO_4+Aq, and dil. $HCl+Aq$. HNO_3+Aq of 1·275 sp. gr. if not diluted has scarcely any solvent action, but more dissolves on dilution until a maximum is reached, when 10 vols. of H_2O have been added. (Bischof, Schw. J. **67.** 39.)

Sol. in 367-403 pts. acetic acid (1·032 sp. gr.) at 22·5°. (Bischof, *l.c.*)

Easily sol. in H_2O containing NH_4Cl, NH_4NO_3, or NH_4 succinate, from which solutions it is completely pptd. by NH_4OH+Aq. (Rose.)

Insol. in Na_2HPO_4 or $BaCl_2+Aq$. (Rose, Pogg. **76.** 23.)

More sol. in $BaCl_2$ or $NaCl+Aq$ than in H_2O, 1 pt. $BaHPO_4$ being sol. in 4362 pts. H_2O containing 1·2 % NaCl and 0·8 % $BaCl_2$. (Ludwig, Arch. Pharm. (2) **56.** 265.)

Sol. in Na citrate + Aq. (Spiller.)

Barium *tetra*hydrogen phosphate, $BaH_4(PO_4)_2$.

Sol. in H_2O. (Mitscherlich, **1821.**)

Decomp. by much H_2O into $BaHPO_4$. Sol. in phosphoric, and certain other acids. (Berzelius, A. ch. **2**. 153.)

Barium *pyro***phosphate**, $Ba_2P_2O_7+xH_2O$.

Somewhat sol. in H_2O, in much $H_4P_2O_7+Aq$, also in $HCl+Aq$ or HNO_3+Aq. Insol. in $HC_2H_3O_2+Aq$ or $Na_4P_2O_7+Aq$. (Schwarzenberg.)

Insol. in NH_4Cl+Aq. (Wackenroder.)

Barium hydrogen *pyro***phosphate**, $BaH_2P_2O_7$, $Ba_2P_2O_7+3H_2O$.

Ppt. (Knorre and Oppelt, B. **21**. 773.)

Barium *tetra***phosphate**, $Ba_2P_4O_{13}$.

Insol. in H_2O or acids when strongly heated. (Fleitmann and Henneberg, A. **65**. 331.)

Barium potassium *trimeta***phosphate**, $BaKP_3O_9+H_2O$.

Much less sol. in H_2O than $NH_4BaP_3O_9$ or $NaBaP_3O_9$. (Lindbom.)

Sol. in $HCl+Aq$ after ignition.

Barium potassium *ortho***phosphate**, $BaKPO_4$.

Insol. in H_2O. (Ouvrard, A. ch. (6) **16**. 297.)

$+10H_2O$. (de Schulten, C. R. **96**. 706.)

Barium sodium *trimeta***phosphate**, $BaNaP_3O_9+4H_2O$.

More easily sol. in H_2O than $Ba_3(P_3O_9)_2$. Sol. in acids, unless ignited. (Fleitmann and Henneberg, A. **65**. 314.)

Efflorescent. Sol. in $HCl+Aq$ after ignition only by long boiling. When fused it is easily sol. in $HCl+Aq$. (Lindbom, Acta Lund. **1873**. 21.)

Barium sodium *ortho***phosphate**, $BaNaPO_4+10H_2O$.

(de Schulten, C. R. **96**. 706.)

Not attacked by cold, but decomp. by hot H_2O. (Villiers, C. R. **104**. 1103.)

Barium sodium *pyro***phosphate**, $6Ba_2P_2O_7$, $Na_4P_2O_7+6H_2O$.

Completely insol. in $Na_4P_2O_7+Aq$, but not insol. in H_2O or NH_4OH+Aq. Easily sol. in HNO_3 or $HCl+Aq$. Insol. in alcohol. (Baer, Pogg. **75**. 164.)

Barium uranyl phosphate, $Ba(UO_2)_2(PO_4)_2+8H_2O$.

Min. *Uranocircite.*

Barium phosphate chloride, $3Ba_3(PO_4)_2$, $BaCl_2$.

Min. *Barytapatite.* (Deville and Caron, A. ch. (3) **67**. 451.)

$4BaH_4(PO_4)_2$, $BaCl_2$. (Erlenmeyer, J. B. **1857**. 145.)

$15BaO$, $6P_2O_5$, $BaCl_2+6H_2O$ (?). Sol. in 18,000 pts. cold H_2O. Much more sol. in H_2O containing $BaCl_2$, NH_4Cl, and NH_4OH. (Ludwig, Arch. Pharm. (2) **56**. 271.)

Bismuth *ortho***phosphate, basic**, $2BiPO_4$, $3Bi_2O_3$.

Insol. in H_2O. Sol. in $HCl+Aq$. (Cavazzi, Gazz. ch. it. **14**. 289.)

Bismuth *ortho***phosphate**, $BiPO_4$.

Insol. in H_2O or HNO_3+Aq. Sl. sol. in NH_4 salts$+Aq$. (Chancel, C. R. **50**. 416.)

More sol. in $HCl+Aq$ than in HNO_3+Aq. (Rose.)

Sol. in $UO_2(NO_3)_2+Aq$. (M'Curdy, Am. J. Sci. (2) **31**. 282.)

Insol. in MNO_3+Aq.

Insol. in Bi salts$+Aq$. (Rose, Pogg. **76** 26.)

Sol. in NH_4Cl+Aq, but insol. in NH_4NO_3+Aq. (Brett, **1837**.)

$+1\frac{1}{2}H_2O$. (Kühn.)

Bismuth *pyro***phosphate, basic**, $2Bi_2O_3$, P_2O_5.

Insol. in H_2O and $HC_2H_3O_2+Aq$; sol. in hot HCl and HNO_3+Aq. Insol. in $Na_4P_2O_7+Aq$, and NH_4 citrate$+Aq$. (Passerini, Cim. **9**. 84.)

Bismuth *pyro***phosphate**, $Bi_4(P_2O_7)_3$.

Insol. in H_2O or HNO_3+Aq. (Chancel, C. R. **50**. 416.)

Decomp. by H_2O. (Wallroth, Bull. Soc. (2) **39**. 316.)

Sol. in $Na_4P_2O_7+Aq$. (Stromeyer.)

Boron phosphate, BPO_4.

Insol. in H_2O. Not attacked by boiling alkalies. (Meyer, B. **22**. 2919.)

Bromomolybdenum phosphate.

See under **Bromomolybdenum comps.**

Cadmium *meta***phosphate.**

Very sol. in NH_4OH+Aq. (Persoz, A. ch. **56**. 334.)

Cadmium *tetrameta***phosphate.**

Insol. in H_2O. Easily decomp. by Na_2S+Aq. (Fleitmann, Pogg. **78**. 358.)

Cadmium *ortho***phosphate**, $Cd_3(PO_4)_2$.

Ppt. Insol. in H_2O. Sol. in Cd salts$+Aq$. (Stromeyer.)

Easily sol. in NH_4 sulphate, chloride, nitrate, or succinate$+Aq$. (Wittstein, Repert. **57**. 32.)

$H_2Cd_5(PO_4)_4+4H_2O$. Sol. in dil. H_3PO_4+Aq. (de Schulten, Bull. Soc. (3) **1**. 473.)

Cadmium *tetra***hydrogen phosphate**, $CdH_4(PO_4)_2+2H_2O$.

Decomp. by great excess of H_2O. (de Schulten.)

Cadmium *pyro***phosphate**, $Cd_2P_2O_7+2H_2O$.

Insol. in H_2O. Sol. in NH_4OH, $Na_4P_2O_7+Aq$, or acids. Insol. in $KOH+Aq$. Sol. in SO_2+Aq. (Schwarzenberg, A. **65**. 183.)

Cadmium potassium *ortho***phosphate**, $CdKPO_4$.

Insol. in H_2O; sol. in dil. $HCl+Aq$. (Ouvrard, A. ch. (6) **16**. 321.)

Cadmium potassium *pyro***phosphate**, $CdK_2P_2O_7$.

Insol. in H_2O; sol. in dil. $HCl+Aq$. (Ouvrard.)

$5Cd_2P_2O_7$, $4K_4P_2O_7+30H_2O$. Much more easily sol. in H_2O than the CdNa salt. (Pahl, Sv. V. A. F. **30**, **7**. 39.)

Cadmium sodium *ortho***phosphate,** $CdNa_4(PO_4)_2$.

Insol. in H_2O; very sol. in dil. acids.

$CdNaPO_4$. As above. (Ouvrard.)

Cadmium sodium *pyro***phosphate,** $CdNa_2P_2O_7$.

Sol. in dil. acids, even acetic acid. (Wallroth.)

$+4H_2O$. Insol. in H_2O. (Pahl, Sv. V. A. F. **30**, **7**. 39.)

Cadmium phosphate bromide, $3Cd_3(PO_4)_2, CdBr_2$.

Sol. in cold very dil. HNO_3+Aq. (de Schulten, Bull. Soc. (3) **1**. 472.)

Cadmium phosphate chloride, $3Cd_3(PO_4)_2, CdCl_2$.

Sol. in dil. HNO_3+Aq. (de Schulten.)

Calcium *monometa***phosphate,** $Ca(PO_3)_2$.

Insol. in H_2O and dil. acids. (Maddrell, A. **61**. 61.)

Not decomp. by digestion with alkali carbonates+Aq. (Fleitmann.)

Calcium *dimeta***phosphate,** $Ca_2(P_2O_6)_2+4H_2O$.

Insol. in H_2O. Decomp. by warm H_2SO_4, but not appreciably by conc. HCl or HNO_3+Aq. (Fleitmann, Pogg. **78**. 255.)

Calcium *hexameta***phosphate** (?).

Insol. in H_2O. Sol. in $Na_6P_6O_{18}$+Aq and in HCl+Aq. (Rose, Pogg. **76**. 3.)

$Ca_3P_6O_{18}$. Nearly insol. in H_2O; sol. in dil. acids. (Lüdert, Z. anorg. **5**. 15.)

Calcium *ortho***phosphate, basic,** $3Ca_3(PO_4)_2+CaO_2H_2$.

(Warington, J. B. **1873**. 253.)

$4CaO, P_2O_5$. (Hilgenstock.)

Calcium phosphate, $Ca_3(PO_4)_2$.

Decomp. by long boiling with H_2O into basic salt, $3Ca_3(PO_4)_2, CaO_2H_2$. This decomp. begins with cold H_2O, so that the solubility at 6-8° varies from 9·9 to 28·6 mg. in a litre. (Warington, Chem. Soc. (2) **11**. 983.)

1 l. cold H_2O dissolves in 7 days 31 mg. ignited, and 79 mg. freshly precipitated $Ca_3(PO_4)_2$. (Völcker, J. B. **1862**. 131.)

100,000 pts. H_2O dissolve 2·36 pts. gelatinous Ca phosphate; 2·56 pts. ignited Ca phosphate; 3·00 pts. Ca phosphate from bone dust. (Maly and Donath, J. pr. (2) **7**. 416.)

Solubility of bones in various solvents is given by Maly and Donath, *l.c.*

Sol. in CO_2+Aq.

1 l. H_2O containing 1 vol. CO_2 dissolves in 12 hours at 10° 0·75 g. precipitated $Ca_3(PO_4)_2$; 0·166 g. $Ca_3(PO_4)_2$ from bone ash; 0·300 g. $Ca_3(PO_4)_2$ from bones which had been buried 20 years. (Lassaigne, J. ch. méd. (3) **3**. 11.)

1 l. H_2O containing 0·8 vol. CO_2 dissolves 0·61 g. $Ca_3(PO_4)_2$. (Liebig, A. **106**. 196.)

H_2O sat. with CO_2 at 5-10° and 760 mm. pressure dissolves 0·527-0·60 g. $Ca_3(PO_4)_2$, or, if containing 1 % NH_4Cl, 0·739 g. $Ca_3(PO_4)_2$. (Warington, Chem. Soc. (2) **9**. 80.)

Solubility varies according to form of $Ca_3(PO_4)_2$.

In apatite, 1 pt. $Ca_3(PO_4)_2$ dissolves in 222,222 pts. H_2O sat. with CO_2; in raw bones, in 5698 pts.; in bone ash, in 8029 pts.; in So. Carolina phosphate, in 6983 pts.; in phosphatic guano from Orchilla Id., in 8009 pts. (Williams, C. N. **24**. 306.)

$Al_2O_6H_6$ and $Fe_2O_6H_6$ prevent the solubility of $Ca_3(PO_4)_2$ in H_2O containing CO_2. (Warington, *l.c.*)

Sol. in SO_2+Aq, forming a liquid of 1·3 sp. gr. at 9° from freshly precipitated $Ca_3(PO_4)_2$, and of 1·188 sp. gr. from bone ash.

Sol. in H_2S+Aq. 1 l. H_2O sat. with H_2S dissolves 190-240 mg. $Ca_3(PO_4)_2$. (Béchamp, A. ch. (4) **16**. 241.)

Easily sol. in HNO_3 or HCl+Aq.

100 pts. very dil. HCl+Aq dissolve 198-225 pts. $Ca_3(PO_4)_2$. (Crum, A. **63**. 294.)

100 pts. HCl of 1·153 sp. gr. (containing 31 % HCl) dissolve at 17° when diluted with:

0	1	4	7	pts. H_2O,
25·3	45·0	62·3	64·7	pts. $Ca_3(PO_4)_2$,
10	13	16	19	pts. H_2O.
68·0	71·9	69·5	69·7	pts. $Ca_3(PO_4)_2$.

(Bischof, Schw. J. **67**. 39.)

Decomp. by H_2SO_4.

Completely decomp. to $CaSO_4$ and H_3PO_4 by a mixture of H_2SO_4 and alcohol.

Solubility in HNO_3+Aq.

1 pt. of $Ca_3(PO_4)_2$ dissolves at 16·25-17·5° in pts. HNO_3+Aq which contain pts. H_2O to 1 pt. HNO_3 (sp. gr. = 1·23).

Pts. HNO_3+Aq	Pts. H_2O	Pts. HNO_3+Aq	Pts. H_2O
2·72	0	30·64	10·754
4·23	0·827	26·48	13
10·25	3·309	32·14	13·236
15·45	5·791	36·06	15·718
20·34	8·273	127·81	40
20·82	10	...	...

(Bischof, **1833**.)

More sol. in acetic, lactic, malic, and tartaric acids than in HCl or HNO_3+Aq. (Crum.)

Sol. in H_3PO_4+Aq.

Very small quantities of the salts of the alkali metals increase the solubility in H_2O. (Lassaigne, J. chim. méd. (3) **3**. 11.)

1 litre cold H_2O with 2 g. NaCl dissolves 45·7 mg. $Ca_3(PO_4)_2$; with 3 g. $NaNO_3$, 33 mg. $Ca_3(PO_4)_2$. (Liebig.)

1 litre H_2O containing 8·75 % NaCl dissolves 317·5 mg. $Ca(PO_4)_2$. (Lassaigne.)

NH_4 salts have even more effect, especially NH_4Cl+Aq, which dissolves $Ca_3(PO_4)_2$ in the cold; also ammonium nitrate and succinate. (Wittstein.)

$(NH_4)_2SO_4$+Aq dissolves $Ca_3(PO_4)_2$ as easily as $CaSO_4$. (Liebig, A. **61**. 128.)

1 litre H_2O containing 2 g. NaCl dissolves at 7-12·3° 45·7 mg. $Ca_3(PO_4)_2$; 3 g. $NaNO_3$ at 17·3°, 33 mg. $Ca_3(PO_4)_2$; 2·2 g. $(NH_4)_2SO_4$, 76·7 mg. $Ca_3(PO_4)_2$. (Liebig, A. **106**. 185.)

Dry $Ca_3(PO_4)_2$ also dissolves by long boiling with solutions of ammonium chloride, nitrate, succinate (Wittstein), or sulphate (Delkeskamp).

Sol. in 89,448 pts. H_2O (boiled) at 7°; 19,628 pts. H_2O (boiled) containing 1 % NH_4Cl at 10°; 4324 pts. H_2O (boiled) containing 10 % NH_4Cl at 17°; 1788 pts. H_2O sat. with CO_2 and containing 10 % NH_4Cl at 10° and 751 mm. pressure; 1351 pts. H_2O sat. with CO_2 and containing 1 % NH_4Cl at 12° and 745 mm. pressure; 42,313 pts. H_2O sat. with CO_2 and containing $CaCO_3$ at 21° and 756·3 mm. pressure; 18,551 pts. H_2O sat. with CO_2 and containing $CaCO_3$ and 1 % NH_4Cl at 16° and 746·1 mm. pressure. (Warington, Chem. Soc. (2) **4.** 296.)

Aqueous solutions of the following NH_4 salts dissolve the given amts. of $Ca_3(PO_4)_2$, calculated for 100 pts. of the corresponding acid: NH_4Cl, 0·655 pt.; NH_4NO_3, 0·306 pt.; $(NH_4)_2SO_4$, 1·050 pts.; $NH_4C_2H_3O_2$, 0·255 pt.; NH_4 tartrate, 4·56 pts.; NH_4 citrate, 7·015 pts.; NH_4 malate, 1·125 pts. $Ca_3(PO_4)_2$. (Terreil, Bull. Soc. (2) **35.** 578.)

Sol. in sodium citrate + Aq. (Spiller.)

Ammonium citrate solution of 1·09 sp. gr. at 30-35° dissolves precipitated $Ca_3(PO_4)_2$ completely, but not phosphorite. (Fresenius.)

Dried on the air, with $2\frac{1}{2}H_2O$. Sol. in 40 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr = 1·09) dissolves 55·3 % of the P_2O_5; citric acid + Aq ($\frac{1}{4}$ %) dissolves 83·8 % of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Dried at 50°, *with* $1\frac{7}{8}H_2O$. Sol. in 45 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq dissolves 52·3 % of the P_2O_5. (Erlenmeyer.)

Ignited. Diammonium citrate + Aq (sp. gr. 1·09) dissolves 93 % of the P_2O_5; triammonium citrate + Aq (sp. gr. 1·09) dissolves 32 % of the P_2O_5; citric acid ($\frac{1}{4}$ %) dissolves 53·4 % of the P_2O_5. (Erlenmeyer.)

$Ca_3(PO_4)_2$ is sol. in $K_2C_2O_4$ + Aq. 100 ccm. $K_2C_2O_4$ + Aq ($1\frac{1}{2}$ % $K_2C_2O_4$) dissolves 57·1 % of the P_2O_5 from phosphorite, 71 % from guano by boiling 25 min. At ord. temp. bone meal gives up 50-80 % of its P_2O_5 to $K_2C_2O_4$ + Aq in 36 hours. (Liebig, Landw. J. B. **1881.** 603.)

Sol. in Ca sucrate + Aq. (Bobierre, C. R. **32.** 859.)

More sol. in H_2O containing starch, glue, or other animal substances than in pure H_2O. (Vauquelin, Pogg. **85.** 126.)

Sol. in H_2O containing organic matter, therefore when bones decay under H_2O, $Ca_3(PO_4)_2$ is dissolved in considerable quantity. (Hayes, Edin. Phil. J. **5.** 378.)

Insol. in alcohol and ether.

Calcium hydrogen phosphate, $CaHPO_4$, and $+2H_2O$.

Insol. or nearly so in H_2O. Gradually decomp. by cold, more quickly by hot H_2O.

1000 pts. H_2O dissolve 0·135-0·152 pt. $CaHPO_4 + 2H_2O$. Solution clouds up on boiling. (Birnbaum.)

1000 pts. H_2O dissolve 0·28 pt., and if sat. with CO_2, 0·66 pt. $CaHPO_4 + 2H_2O$. (Dusart and Pelouze.)

1 l. H_2O containing 2·2 g. $(NH_4)_2SO_4$, 2 g. NaCl, or 3 g. $NaNO_3$ dissolves 79·2, 66·3, or 78·9 mg. CaP_2O_7, which is present in form of $CaHPO_4$. (Liebig, A. **106.** 185.) Slowly but completely sol in boiling NH_4Cl + Aq. (Kraut, Arch. Pharm. (2) **111.** 102.) Easily sol. in H_2SO_3 + Aq. (Gerland, J. pr. (2) **4.** 123.) Very sol. in HCl or HNO_3 + Aq. Less sol. in $HC_2H_3O_2$. (Berzelius.) More sol. in dil. than conc. $HC_2H_3O_2$ + Aq, but 60 pts. $HC_2H_3O_2$ (1 mol.) dissolve at most 23·1 pts. P_2O_5 (1 mol. = 142 pts.) from this compound. Aqueous solution of sodium acetate dissolves more easily than H_2O, and becomes turbid on boiling. (Birnbaum.)

Completely sol. in $K_2C_2O_4$ + Aq. (Liebig, Landw. J. B. **1881.** 603.)

Insol. in alcohol. Sol. in many organic substances, as starch or gelatine + Aq.

$+\frac{1}{3}H_2O$. (Vorbringer, Z. anal. **9.** 457.)
$+H_2O$. (Gerlach, J. pr. (2) **4.** 104.)
$+2H_2O$. Min. *Brushite.*
$+3H_2O$. Min. *Metabrushite.*
$+5H_2O$. (Dusart, C. R. **66.** 327.)

Calcium *tetra***hydrogen** *ortho***phosphate,** $CaH_4(PO_4)_2 + H_2O$.

Very deliquescent. Crystals take up 97·7 pts. H_2O in 16 days, and 226 pts. H_2O in 28 days from air saturated with moisture. (Birnbaum, Zeit. Ch. (2) **7.** 131.)

Not hygroscopic when pure. (Stocklasa, B. **23.** 626 R.)

Completely sol. in 100 pts. H_2O, but decomp. by 10-40 pts. H_2O with separation of $CaHPO_4$, which slowly dissolves. (Erlenmeyer, J. B. **1873.** 254.)

Later (B. **9.** 1839) Erlenmeyer says $CaH_4(PO_4)_2 + H_2O$ is sol. in 700 pts. H_2O and decomp. into $CaHPO_4$ by a less amount of H_2O. Wattenberg (Z. anal. **19.** 243) says that the decomposition by small amts. of H_2O down to 144 pts. H_2O to 1 pt. salt is inappreciable.

Completely sol. in 200 pts. H_2O if pure, and in less H_2O in presence of H_3PO_4. (Stocklasa.)

Sol. in 25 pts. H_2O at 15°. Solution begins to decompose when warmed to 50°. (Otto, C. C. **1887.** 1563.)

Glacial $HC_2H_3O_2$ ppts. it completely from aqueous solution even in presence of HNO_3. (Persoz.)

Decomp. by 50 pts. absolute alcohol at b.-pt. in 1 hour; by 30 pts. in 2 hours. Sol. in absolute ether. (Erlenmeyer, *l.c.*)

Calcium *pyro***phosphate**, $Ca_2P_2O_7 + 4H_2O$.

Somewhat sol. in H_2O, completely sol. in mineral acids, less sol. in acetic acid, and insol. in $Na_4P_2O_7$ + Aq. (Schwarzenberg, A. **65.** 145.) Less sol. in warm than in cold acetic acid. (Baer, Pogg. **75.** 155.)

Insol. in NH_4Cl + Aq. (Wackenroder, A. **41.** 316.)

Insol. in $CaCl_2$ + Aq.

Min. *Pyrophosphorite.*

Calcium hydrogen *pyro***phosphate,** $CaH_2P_2O_7 + 2H_2O$.

Sol. in H_2O. (Pahl, B. **7.** 478.)

$2CaH_2P_2O_7, Ca_2P_2O_7+6H_2O$. Decomp. by boiling with H_2O into—

$CaH_2P_2O_7, Ca_2P_2O_7+3H_2O$. Insol. in hot H_2O. (Knorre and Oppelt, B. **21**. 771.)

***Tetra*calcium hydrogen phosphate,** $Ca_4H(PO_4)_3+H_2O$.

Ppt. Insol. in H_2O, but decomp. by boiling therewith. Sol. in acids. (Warington, Chem. Soc. (2) **4**. 296.)

$+2H_2O$.

Calcium *tetra*phosphate, $Ca_3P_4O_{13}$.

Insol. in acids when ignited. (Fleitmann and Henneberg, A. **65**. 331.)

Calcium lithium phosphate, $CaLiPO_4$.

Insol. in H_2O. (Rose, Pogg. **77**. 298.)

Calcium potassium *ortho*phosphate, $CaKPO_4$.

Insol. in H_2O. (Rose, Pogg. **77**. 291.)

Easily sol. in acids. (Ouvrard, A. ch. (6) **16**. 308.)

Calcium potassium *pyro*phosphate, $CaK_2P_2O_7$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106**. 1599.)

Calcium sodium *trimeta*phosphate, $CaNaP_3O_9+3H_2O$.

Sl. sol. in H_2O. (Fleitmann, A. **65**. 315.)

Easily sol. in H_2O. Difficultly sol. in HCl+Aq when heated to redness. Easily sol. in boiling HCl+Aq after being fused. (Lindbom.)

Calcium sodium *ortho*phosphate, $CaNaPO_4$.

Insol. in H_2O. (Rose, Pogg. **77**. 292.)

Easily sol. in dil. acids. (Ouvrard, A. ch. (6) **16**. 308.)

Calcium sodium *pyro*phosphate, $CaNa_2P_2O_7+4H_2O$.

Insol. in $Na_4P_2O_7$+Aq. Easily sol. in HCl+Aq, HNO_3+Aq, and also in $HC_2H_3O_2$+Aq. (Baer, Pogg. **75**. 159.)

Calcium sodium *pyro*phosphate, $Ca_{10}Na_{16}(P_2O_7)_9$.

Sol. in acids. (Wallroth, Bull. Soc. (2) **39**. 316.)

$3CaO, 3Na_2O, 2P_2O_5$. Easily sol. in acids. (Ouvrard, A. ch. (6) **16**. 307.)

Calcium uranyl phosphate, $Ca(UO_2)H_2(PO_4)_2+$ 2, 3, or $4H_2O$.

Sol. in HNO_3+Aq. (Debray.)

$Ca(UO_2)_2(PO_4)_2+8H_2O$. Min. *Uranite*. Sol. in HNO_3+Aq.

Calcium phosphate chloride, $Ca_3(PO_4)_2, CaCl_2$.

(Deville and Caron, A. ch. (3) **67**. 458.)

Calcium phosphate chloride, $3Ca_3(PO_4)_2CaCl_2$.

Chlorapatite. Insol. in H_2O. (Daubrée, Ann. Min. (4) **19**. 684.)

Calcium phosphate chloride, $7CaH_4(PO_4)_2, CaCl_2+14H_2O$.

Sol. in HCl+Aq.

$4CaH_4(PO_4)_2, CaCl_2+8H_2O$.

$CaH_4(PO_4)_2, CaCl_2+2H_2O$. Partly sol. in H_2O with decomp. Also with $8H_2O$. (Erlenmeyer, J. B. **1857**. 145.)

Calcium phosphate chloride fluoride, $3Ca_3(PO_4)_2, CaClF$.

Min. *Apatite*. Boiling H_2O dissolves out $CaCl_2$; dil. mineral acids dissolve easily, acetic acid with more difficulty. Easily soluble in molten NaCl, crystallising on cooling. (Forchhammer.)

Calcium phosphate silicate, $Ca_3(PO_4)_2, Ca_2SiO_4$.

Insol. in H_2O; decomp. by HCl+Aq. (Carnot and Richard, C. R. **97**. 316.)

$4Ca_3(PO_4)_2, Ca_3SiO_5$. (Bücking and Linck, C. C. **1887**. 562.)

$4Ca_3(PO_4)_2, 3Ca_3SiO_5$. (B. and L.)

$Ca(PO_3)_2, CaSiO_3$. (Stead and Ridsdate, Chem. Soc. **51**. 601.)

Calcium *di*hydrogen phosphate sulphite, $CaH_2(PO_4)_2, CaSO_3+H_2O$.

Not decomp. by cold, slowly by boiling H_2O. Slightly sol. in NH_4OH+Aq. Sol. in mineral acids. Insol. in cold, slowly sol. in boiling acetic acid. More sol. in a solution of oxalic acid. (Gerland, C. N. **20**. 268.)

Cerous *meta*phosphate, $Ce(PO_3)_3$.

(Rammelsberg.)

$Ce_2O_3, 5P_2O_5$. Insol. in H_2O or acids. (Johnsson, B. **22**. 976.)

Cerous *ortho*phosphate, $CePO_4$.

Insol. in H_2O. Easily sol. in acids. (Grandeau, A. ch. (6) **8**. 193.)

Insol. in acids. (Hartley, Proc. Roy. Soc. **41**. 202.)

$+2H_2O$. Insol. in H_2O. Sol. in acids. (Jolin.)

Insol. in H_3PO_4+Aq; sl. sol. in HCl or HNO_3+Aq. (Hisinger.)

Insol. in HNO_3+Aq. (Boussingault, A. ch. (5) **5**. 178.)

Min. *Cryptolite*. Completely decomp. by H_2SO_4 when finely powdered. Insol. in dil. HNO_3+Aq.

Ceric *ortho*phosphate, $4CeO_2, 6P_2O_5+26H_2O$.

Ppt. (Hartley, Proc. Roy. Soc. **41**. 202.)

Cerous *pyro*phosphate, $Ce_2H_2(P_2O_7)_6+6H_2O$.

Sol. in cerous nitrate+Aq.

Cerous lanthanum thorium phosphate, $(Ce, La, Th)_2(PO_4)_2$.

Min. *Monazite*. Sol. in HCl+Aq with white residue.

Cerous potassium *ortho*phosphate, $2Ce_2O_3, 3K_2O, 3P_2O_5=2CePO_4, K_3PO_4$.

Insol. in H_2O; sol. in acids. (Ouvrard, C. R. **107**. 37.)

Cerous sodium *ortho*phosphate, $Ce_2O_3, 3Na_2O, 2P_2O_5=CePO_4, Na_3PO_4$.

Insol. in H_2O. (Ouvrard, C. R. **107**. 37.)

Cerous sodium *pyro*phosphate, $CeNaP_2O_7$.

Insol. in acetic, and cold dil. mineral acids. Sol. in warm acids. (Wallroth.)

Chromous phosphate, $Cr_3(PO_4)_2+H_2O$.

Precipitate. Easily sol. in acids. (Moberg; Moissan, A. ch. (5) **21.** 199.)

Chromic *meta***phosphate**, $Cr_2(PO_3)_6$.

Insol. in H_2O or conc. acids. (Maddrell, A. **61.** 53.)

Chromic phosphate, $Cr_2(PO_4)_2+12H_2O$.

Violet modification. Precipitate. (Rammelsberg, Pogg. **68.** 383.)

$+4H_2O$. *Green modification.* Very sl. sol. in H_2O and still less in NH_4NO_3 or $NH_4C_2H_3O_2$+Aq. (Carnot, C. R. **94.** 1313.)

Insol. in acetic, but easily sol. in mineral acids. Easily sol. in cold KOH or NaOH+Aq, from which it is separated on boiling. (Dowling and Plunkett, Chem. Gaz. **1858.** 220.)

Chromic hydrogen phosphate, $Cr_2H_6(PO_4)_4+16H_2O$.

Sol. in H_2O. (Haushofer.)

Chromic *pyro***phosphate**, $Cr_4(P_2O_7)_3$.

Anhydrous. Insol. in H_2O or acids. (Ouvrard, A. ch. (6) **16.** 344.)

$+7H_2O$. Precipitate. Sol. in strong mineral acids, SO_2+Aq, KOH+Aq, and $Na_4P_2O_7$+Aq. (Schwarzenberg, A. **65.** 149.)

Insol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Chromic potassium phosphate, Cr_2O_3, K_2O, $2P_2O_5$.

Insol. in H_2O and in acids. (Ouvrard, A. ch. (6) **16.** 289.)

Chromic potassium *pyro***phosphate**, $Cr_2K_2H_4(P_2O_7)_3$.

Insol. in H_2O, acids, or alkalies. Sl. decomp. by boiling conc. H_2SO_4. (Schjerning, J. pr. (2) **45.** 515.)

Chromic silver phosphate, $2Cr_2O_3$, $2Ag_2O$, $5P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 1142.)

Chromium sodium *pyro***phosphate**, $Cr_2Na_2(P_2O_7)_2$.

Insol. in acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

Cobaltous *monometa***phosphate**, $Co(PO_3)_2$ (?).

Insol. in H_2O and dil. acids. Sol. in conc. HCl+Aq. (Maddrell, A. **58.** 61.)

Cobaltous *dimeta***phosphate**, $Co_2(P_2O_6)_2$.

Insol. in cold conc. H_2SO_4; sl. sol. on warming, but sol. in H_2O after treating with H_2SO_4. Sol. in conc. NH_4OH+Aq. Scarcely attacked by boiling Na_2S+Aq. (Fleitmann.)

Cobaltous *hexameta***phosphate** (?).

Ppt. Sol. in sodium hexametaphosphate+Aq. (Rose, Pogg. **76.** 4.)

Cobaltous *ortho***phosphate**, $Co_3(PO_4)_2+xH_2O$.

Sol. in H_3PO_4+Aq or NH_4OH+Aq; sl. sol. in NH_4Cl or NH_4NO_3+Aq. (Salvetat, C. R. **48.** 295.) Sol. in Co salts+Aq.

$+2H_2O$. (Debray, A. ch. (3) **61.** 438.)

$+8H_2O$. (Reynoso, C. R. **34.** 795.)

Cobaltous hydrogen *ortho***phosphate**, $CoHPO_4+1\frac{1}{2}H_2O$.

Ppt. (Debray.)

$+2\frac{1}{2}H_2O$. Ppt. Insol. in H_2O. Sol. in H_3PO_4+Aq. (Bödeker, A. **94.** 357.)

Cobaltous *tetra***hydrogen** *ortho***phosphate**, $CoH_4(PO_4)_2$.

Sol. in H_2O. (Reynoso.)

Cobaltous *pyro***phosphate**.

Ppt. Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Sol. in NH_4OH+Aq. (Schwarzenberg.)

Cobaltous *pyrometa***phosphate**, $3CoO$, $2P_2O_5$. (Braun.)

$6CoO$, $5P_2O_5$. (Braun.)

Cobaltous potassium phosphate, $CoKPO_4$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$3CoO$, $3K_2O$, $2P_2O_5$. As above.

Cobaltous sodium *meta***phosphate**, $Co_2Na_2(PO_3)_6$.

Insol. in H_2O or acids, even conc. H_2SO_4. (Watts' Dict.)

Cobaltous sodium *monometa***phosphate**, $6Co(PO_3)_2$, $2NaPO_3$.

Insol. in H_2O and dil. acids. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 57.)

Cobaltous sodium *trimeta***phosphate**, $CoNa_4(PO_3)_6+8H_2O$.

Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 315.)

Cobaltous sodium *ortho***phosphate**, $CoNaPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **106.** 1729.)

$Co_3(PO_4)_2$, $2Na_2HPO_4+8H_2O$. (Debray, J. Pharm. (3) **46.** 119.)

Cobaltous sodium *pyro***phosphate**, $Co_{10}Na_{20}(P_2O_7)_{10}$.

Insol. in H_2O. Sol. in acids. (Wallroth.)

$+xH_2O$. Sol. in H_2O. (Stromeyer.)

Cobaltous zinc phosphate, $Co_3(PO_4)_2$, $3Zn_3(PO_4)_2+12H_2O$.

Ppt. Sol. in acids. (Gentele.)

$CoZn_2(PO_4)_2+6H_2O$. Insol. in H_2O.

Columbium phosphate (?).

Insol. in H_2O. (Blomstrand.)

Cupric *dimeta***phosphate**, $Cu_2(P_2O_6)_2$.

Insol. in H_2O. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 62.) Insol. in most conc. acids and in alkalies, except hot NH_4OH+Aq or conc. H_2SO_4, in which it is moderately sol.

Not decomp. by H_2S, but by $(NH_4)_2S$+Aq, less easily by Na_2S, and K_2S+Aq. (Fleitmann, Pogg. **78.** 242.)

$+8H_2O$. Completely insol. in H_2O. (Fleitmann.)

Cupric *hexameta***phosphate** (?).

Sol. in $Na_6P_6O_{18}$+Aq or $CuCl_2$+Aq. (Rose, Pogg. **76.** 4.)

$Cu_3P_6O_{18}$. Easily sol. in H_2O or acids, especially when freshly pptd. (Lüdert, Z. anorg. **5.** 15.)

Cupric *ortho*phosphate, basic, $6CuO, P_2O_5+3H_2O$.

Min. *Phosphocalcite.*

$5CuO, P_2O_5+2H_2O$. Min. *Dihydrite.*

$+3H_2O$. Min. *Ehlite.* Easily sol. in NH_4OH+Aq, and HNO_3+Aq.

$4CuO, P_2O_5+H_2O$. Slowly sol. in NH_4OH or $(NH_4)_2CO_3+Aq$; insol. in cold $Na_2S_2O_3+Aq$. (Steinschneider, C. C. **1891, 2.** 51.)

Min. *Libethenite.* Sol. in acids and NH_4OH+Aq.

$+2H_2O$. Min. *Pseudolibethenite.* Sol. in acids and NH_4OH+Aq.

$+3H_2O$. Min. *Tagilite.* Sol. in acids and NH_4OH+Aq.

Cupric *ortho*phosphate, $Cu_3(PO_4)_2+3H_2O$.

Insol. in H_2O; easily sol. in acids, even H_3PO_4, $HC_2H_3O_2$, or H_2SO_3+Aq. Sol. in NH_4OH+Aq. Sl. sol. in NH_4 salts $+Aq$.

Sl. sol. in Cu salts $+Aq$. (Rose, Pogg. **76.** 25.)

Sol. in cold $Na_2S_2O_3+Aq$. (Steinschneider, C. C. **1891, 2.** 51.)

Cupric hydrogen phosphate, $CuHPO_4+1\frac{1}{2}H_2O$ (?).

Insol. in H_2O; sol. in H_3PO_4+Aq, and $HC_2H_3O_2+Aq$. Insol. in NH_4Cl, and NH_4NO_3+Aq. (Brett, Phil. Mag. (3) **10.** 98.)

Cupric *pyro*phosphate, basic, $Cu_2P_2O_7, 2CuO, H_2O+3H_2O$.

Insol. in H_2O. (Pahl, J. B. **1873.** 229.)

Cupric *pyro*phosphate, $Cu_2P_2O_7$.

Anhydrous. Insol. in H_2O, and very sl. sol. in conc. acids. (Fleitmann, Pogg. **78.** 244.)

As insol. as Cu metaphosphate, but decomp. by H_2S. (Rose, Pogg. **76.** 14.)

$+2H_2O$. Sol. in mineral acids, and NH_4OH+Aq; also in $Na_4P_2O_7+Aq$. (Schwarzenberg, A. **65.** 156.)

Sol. in cold H_2SO_3+Aq without decomp., crystallising out on boiling.

Decomp. by boiling $KOH+Aq$.

Sol. in large excess of $CuSO_4+Aq$.

$+2\frac{1}{2}$, and $5H_2O$. (Pahl, Sv. V. A. F. **30, 7.** 40.)

Cupric potassium phosphate, $4CuO, K_2O, 3P_2O_5$.

Insol. in H_2O. (Ouvrard, C. R. **111.** 177.)

$CuKPO_4$. As above.

Cupric potassium *pyro*phosphate, $CuK_2P_2O_7$.

Extremely easily sol. in H_2O. (Persoz, A. ch. (3) **20.** 315.)

$Cu_2P_2O_7, 3K_4P_2O_7+4H_2O$. Insol. in H_2O. (Pahl, Sv. V. A. F. **30, 7.** 44.)

Cupric sodium phosphate, $Cu_3Na_6(PO_4)_4$.

Insol. in $HC_2H_3O_2+Aq$. Sol. in conc. acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

Cupric sodium *tetrameta*phosphate, $CuNa_2P_4O_{12}$.

As insol. in H_2O as Cu dimetaphosphate. Difficultly decomp. by digestion with Na_2S+Aq. (Fleitmann, Pogg. **78.** 355.)

Cupric sodium phosphate, $3Cu_3(PO_4)_2, NaH_2PO_4$.

Decomp. by H_2O to $4CuO, P_2O_5$. (Steinschneider, C. C. **1891, 2.** 52.)

$2Cu_3(PO_4)_2, Na_2HPO_4$. Decomp. by H_2O into—

$3Cu_3(PO_4)_2, Na_2HPO_4$. Decomp. by H_2O. (S.)

$Cu_3(PO_4)_2, NaH_2PO_4$. Decomp. by H_2O. (S.)

$6Cu_3(PO_4)_2, 2Na_3PO_4$. Decomp. by H_2O. (S.)

Cupric sodium *pyro*phosphate, $CuNa_2P_2O_7$.

Insol. in H_2O. (Fleitmann and Henneberg, A. **65.** 387.)

$+\frac{2}{3}H_2O$. (F. and H.) Much more sol. than the next salt. (Pahl.)

$+6H_2O$. (Persoz, A. ch. (3) **20.** 315.)

$Cu_2P_2O_7, CuNa_2P_2O_7+3\frac{1}{2}H_2O$. Very efflorescent; insol. in H_2O. (F. and H.)

$+10\frac{1}{2}H_2O$. (Pahl, Sv. V. A. F. **30, 7.** 42.)

$CuNa_2P_2O_7, Na_4P_2O_7$. Sol. in H_2O. (F. and H.)

$+2H_2O$. (F. and H.)

$+12$, and $16H_2O$. Very efflorescent, and sol. in H_2O. (Pahl.)

Cupric uranyl phosphate, $(UO_2)_2Cu(PO_4)_2+8H_2O$.

Insol. in H_2O; easily sol. in acids. (Debray.)

Min. *Chalcolite.* Sol. in HNO_3+Aq.

Cupric *ortho*phosphate ammonia, $Cu_3(PO_4)_2, 4NH_3$.

Sl. sol. in H_2O. Easily sol. in H_2O containing NH_4OH. (Schiff, A. **123.** 41.)

$2CuO, 3P_2O_5, 20NH_3+21H_2O$. Easily sol. in cold H_2O, with subsequent decomp. (Metzner, A. **149.** 66.)

$2CuO, P_2O_5, 6NH_3$. (Maumené.)

Cupric *pyro*phosphate ammonia, $8CuO, 3P_2O_5, 4NH_3+4H_2O$.

Sl. sol. in H_2O. (Schwarzenberg, A. **65.** 133.)

$Cu_2P_2O_7, 4NH_3+H_2O$. Sl. sol. in H_2O. (Schiff, A. **123.** 1.)

Didymium *meta*phosphate, $Di(PO_3)_3$.

Precipitate. (Smith.)

$Di_2O_3, 5P_2O_5$. Insol. in H_2O. (Cleve.)

Didymium phosphate, $2Di_2O_3, 3P_2O_5$.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Didymium *ortho*phosphate, $DiPO_4$.

Insol. in H_2O. Very sl. sol. in dil., easily sol. in conc. acids. (Marignac.) Insol. in H_2O. (Wallroth, Bull. Soc. (2) **39.** 316.)

$+H_2O$. (Frerichs and Smith, A. **191.** 355.)

Didymium *tri*hydrogen phosphate, $Di_2H_3(PO_4)_3$.

Precipitate. (Frerichs and Smith.)

Existence is doubtful. (Cleve, B. **12.** 910.)

Didymium *hexa*hydrogen phosphate, $DiH_3(PO_4)_2+H_2O$.

Precipitate. (Hermann.)

Didymium *pyro*phosphate, $Di_4(P_2O_7)_3+6H_2O$.

Precipitate. (Cleve.)

Didymium hydrogen *pyro*phosphate, $Di_2H_6(P_2O_7)_3$.

Precipitate. Sol. in disodium pyrophosphate+Aq. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve.)

Didymium potassium phosphate, $2Di_2O_3, 3K_2O, 3P_2O_5=2DiPO_4, K_3PO_4$.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Didymium sodium *ortho*phosphate, $Di_2O_3, 3Na_2O, 2P_2O_5=DiPO_4, Na_3PO_4$.

Insol. in H_2O. (Ouvrard.)

Didymium sodium *pyro*phosphate, $Di_2O_3, Na_2O, 2P_2O_5=DiNaP_2O_7$.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Erbium phosphate, $ErPO_4+H_2O$.

Precipitate.

Erbium *pyro*phosphate, $ErHP_2O_7+3\frac{1}{2}H_2O$.

Scarcely sol. in boiling H_2O. Slowly sol. in acids.

Erbium sodium *pyro*phosphate, $ErNaP_2O_7$.

Precipitate. (Wallroth.)

Glucinum phosphate, $Gl_3(PO_4)_2+6H_2O$.

Precipitate. Insol. in H_2O. Sol. in acids. (Atterberg, Sv. V. A. Handl. **12, 5.** 33.)

1 l. 2 % $HC_2H_3O_2$+Aq dissolves 0·55 g. of the anhydrous salt; 1 l. 10 % $HC_2H_3O_2$+Aq dissolves 1·725 g. (Sestini, Gazz. ch. it. **20.** 313.)

$+7H_2O$. (Atterberg.)

Glucinum hydrogen phosphate, $GlHPO_4+3H_2O$.

Precipitated by alcohol. (Atterberg.)

Glucinum phosphate, $5GlO, 2P_2O_5+8H_2O$.

Ppt. Sol. in H_2O with decomp. (Scheffer.)

$3GlO, P_2O_5, 3H_2O+H_2O$. (Sestini, Gazz. ch. it. **20.** 313.)

Glucinum *pyro*phosphate, $Gl_2P_2O_7+5H_2O$.

Precipitate. (Scheffer.)

Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Glucinum potassium phosphate, $GlKPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **110.** 1333.)

Glucinum sodium phosphate, $GlNaPO_4$.

Sl. sol. in cold, easily sol. in hot acids. (Wallroth.) Insol. in acetic acid.

Min. *Beryllonite.*

$GlO, 2Na_2O, P_2O_5$. Insol. in H_2O. (Ouvrard, C. R. **110.** 1333.)

Gold (Auric) sodium *pyro*phosphate (?), $Au_4(P_2O_7)_3, 2Na_4P_2O_7+H_2O$.

Sol. in H_2O. (Persoz.)

Iron (Ferrous) *trimeta*phosphate, $Fe(P_3O_9)_3+12H_2O$.

Rather sl. sol. in cold, more easily in hot H_2O. After ignition sol. in HCl+Aq only after long boiling. (Lindbom, Acta Lund. **1873.** 17.)

Ferrous *hexameta*phosphate, $Fe_3P_6O_{18}$.

When freshly pptd. is sol. in H_2O, and very sol. in least traces of acids, or $Na_6P_6O_{18}$+Aq. (Lüdert, Z. anorg. **5.** 15.)

Ferrous phosphate, basic, $7FeO, 2P_2O_5+9H_2O$.

Min. *Ludlamite.* Sol. in dil. H_2SO_4 or HCl+Aq. Decomp. by boiling KOH or NaOH+Aq.

Ferrous phosphate, $Fe_3(PO_4)_2$.

Insol. in H_2O; sol. in acids.

Sol. in 1000 pts. H_2O containing more than 1 vol. CO_2. (Pierre.)

Sol. in an excess of ferrous salts +Aq.

Sol. in 560 pts. H_2O containing $\frac{1}{510}$ pt. $HC_2H_3O_2$. Sol. in 1666 pts. H_2O containing 150 pts. $NH_4C_2H_3O_2$. (Pierre, A. ch. (3) **36.** 78.)

Sol. in NH_4 salts +Aq.

Sol. in NH_4OH+Aq. Not pptd. in presence of Na citrate.

$+H_2O$. (Debray, A. ch. (3) **61.** 437.)

$+8H_2O$. Min. *Vivianite.* Easily sol. in HCl or HNO_3+Aq. Boiling KOH+Aq dissolves out phosphoric acid. Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

Ferrous hydrogen phosphate, $FeHPO_4+H_2O$.

Ppt. (Debray, A. ch. (3) **61.** 437.)

Is impure $Fe_3(PO_4)_2$. (Erlenmeyer and Heinrichs, A. **194.** 176.)

Ferrous *tetra*hydrogen phosphate, $FeH_4(PO_4)_2+H_2O$.

Easily sol. in H_2O. Not changed by alcohol. (Erlenmeyer and Heinrichs, A. **194.** 176.)

Ferrous *pyro*phosphate.

Ppt. Sol. in an excess of $Na_4P_2O_7$ or $FeSO_4$+Aq. (Schwarzenberg, A. **65.** 153.)

Ferric *meta*phosphate, $Fe_2(PO_3)_6$ or $Fe(PO_3)_3$.

Insol. in H_2O or dil. acids. Sol. in conc. H_2SO_4. (Maddrell, Phil. Mag. (3) **30.** 322.)

Ferric *ortho*phosphate, basic, $2Fe_2O_3, P_2O_5+xH_2O$.

Insol. in NH_4 citrate, sol. in NH_4 tartrate +Aq. (Wittstein.)

$+3H_2O$. Min. *Kraurite.* Easily sol. in HCl+Aq.

$+4H_2O$. Ppt. (Millot, C. R. **82.** 89.)

$+5H_2O$. Min. *Dufrenite.*

$+12H_2O$. Min. *Cacoxene.* Sol. in HCl+Aq.

+18, or $24H_2O$. Min. *Delvauxite.*

$5Fe_2O_3, 3P_2O_5+14H_2O$. Min. *Beraunite.* Sol. in HCl+Aq.

$3Fe_2O_3, 2P_2O_5+8H_2O$. Min. *Eleonorite.* Sol. in HCl+Aq.

Ferric *ortho*phosphate, $Fe_2(PO_4)_2+xH_2O$, or $2Fe_2O_3, 3P_2O_5+xH_2O$.

+4 or $8H_2O$. (*Pptd. ferric phosphate.*) Insol. in H_2O. Sol. in 1500 pts. boiling H_2O. (Bergmann, **1815.**) Sol. in pure H_2O when all traces of soluble salts are absent. (Fresenius.) Very sl. sol. in, but decomp. by H_2O. (Lachowicz, W. A. B. **101, 2b.** 374.) Easily sol. in dil. mineral acids, excepting H_3PO_4+Aq. Insol. in cold $HC_2H_3O_2$+Aq. (Wittstein.) 100 ccm. cold H_2O containing 10 % $HC_2H_3O_2$ dissolve 0·007 g. salt. (Sestini, Gazz. ch. it. **5.** 252.) When freshly pptd. easily sol. in H_2SO_3+Aq, or $(NH_4)_2SO_3+Aq$. (Berthier.) Easily sol. in tartaric or citric acid + Aq, also in NH_4 salts of those acids, and Na citrate + Aq. (Heydenreich, C. N. **4.** 158.) See below.

Sol. in 12,500 pts. H_2O sat. with CO_2. (Pierre, A. ch. (3) **36.** 78.)

Insol. in NH_4 salts + Aq. (Wittstein.) Sol. in NH_4OH+Aq in presence of Na_2HPO_4; insol. in hot Na_2HPO_4+Aq; sol. in $(NH_4)_2CO_3+Aq$ (Berzelius). NH_4OH, KOH, or NaOH + Aq dissolve out H_3PO_4.

Sol. in ferric salts + Aq, even ferric acetate, but insol. in ferrous acetate + Aq.

Partially sol. in large amt. of Na_2CO_3+Aq. Not pptd. in presence of Na citrate. (Spiller.)

Arth (Bull. Soc. (3) **2.** 324) obtained a modification of $Fe_2(PO_4)_2$, insol. in HNO_3+Aq, but sol. in hot conc. HCl + Aq.

$+4H_2O$. Min. *Strengite.* Easily sol. in HCl + Aq; insol. in HNO_3+Aq.

$+5H_2O$. Diammonium citrate + Aq dissolves 4·8 % of the P_2O_5; triammonium citrate, 5·8 % P_2O_5; and with an excess of NH_4OH, 21·2 % P_2O_5 is dissolved. (Erlenmeyer, B. **14.** 1253.)

$+9H_2O$. Dissolves in 35 min. in diammonium citrate + Aq (sp. gr. 1·09); in 55 min. in triammonium citrate + Aq (sp. gr. 1·09); citric acid + Aq (¼ % citric acid) dissolves 17·5 % of the P_2O_5. (Erlenmeyer, *l.c.*)

Ferric phosphate, acid, $8Fe_2O_3, 9P_2O_5+3H_2O$.

Insol. in H_2O. (Rümpler, Z. anal. **12.** 151.)

$6Fe_2O_3, 7P_2O_5+3H_2O$.

$4Fe_2O_3, 5P_2O_5+3H_2O$.

$2Fe_2O_3, 3P_2O_5+8H_2O$. Ppt. Decomp. by H_2O finally into $Fe_2(PO_4)_2$. (Erlenmeyer and Heinrich, A. **194.** 176.)

$8Fe_2O_3, 11P_2O_5+9H_2O$. As above. (E. and H.)

$4Fe_2O_3, 7P_2O_5+9H_2O$. As above. (E. and H.)

$Fe_2O_3, 2P_2O_5+8H_2O$. Insol. in H_2O or $HC_2H_3O_2+Aq$; sol. in NH_4 citrate, alkali hydrates, or carbonates + Aq. (Winkler.) Slowly decomp. by H_2O. (E. and H.)

$+10H_2O$. (Waine, C. N. **36.** 132.)

$2Fe_2O_3, 5P_2O_5+17H_2O$.

$Fe_2O_3, 3P_2O_5+6H_2O=FeH_6(PO_4)_3$. Deliquescent. Insol. in H_2O, but decomp. into $Fe_2(PO_4)_2$. (E. and H.)

$+4H_2O$. (Hautefeuille and Margottet, C. R. **106.** 135.)

Ferric *pyro***phosphate,** $Fe_4(P_2O_7)_3$.

Two modifications. — (*a*) Sol. in acids, $Na_4P_2O_7+Aq$, $FeCl_3+Aq$, NH_4OH+Aq, and in $(NH_4)_2CO_3+Aq$.

Insol. in acetic, sulphurous acid, or NH_4Cl+Aq. Sol. in NH_4 citrate + Aq. (Schwarzenberg, A. **65.** 153.)

(*b*) Insol. in dil. acids, $Na_4P_2O_7+Aq$, $FeCl_3+Aq$. Sol. in NH_4OH+Aq. (Gladstone, Chem. Soc. (2) **5.** 435.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. **6.** 184.)

Ferroferric *ortho***phosphate,** $2Fe_3(PO_4)_2$, $3(Fe_2O_3, 2P_2O_5)+16H_2O$.

Ppt. Sol. in HCl + Aq. (Rammelsberg.)

$4Fe_2O_3, 6FeO, 5P_2O_5+40H_2O$. Sol. in 40 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr. = 1·09) dissolves 55·7 % of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Ferrous lithium phosphate, Li_3PO_4, $Fe_3(PO_4)_2$.

Min. *Triphylline.* Easily sol. in acids; not wholly decomp. by KOH + Aq.

Ferrous manganous phosphate, $Fe_3(PO_4)_2$, $Mn_3(PO_4)_2$.

Min. *Triplite.* Easily sol. in HCl + Aq.

$5(Mn, Fe)O, 2P_2O_5+5H_2O$. Min. *Hureaulite.* Sol. in acids.

Ferric manganous sodium phosphate, $FePO_4, (Na_2, Mn)_3PO_4+\frac{1}{2}H_2O$.

Min. — (?).

Ferrous manganous phosphate chloride, $3(Mn, Fe)_3(PO_4)_2, MnCl_2$.

(Deville and Caron.)

Ferrous manganous phosphate fluoride, $(Mn, Fe)_3(PO_4)_2, (Mn, Fe)F_2$.

Min. *Triplite, Zwieselite.* Sol. in HCl + Aq.

$3(Mn, Fe)_3(PO_4)_2, MnF_2$. (Deville and Caron, C. R. **47.** 985.)

Ferric potassium phosphate, $2Fe_2O_3, 3K_2O, 3P_2O_5$.

Not attacked by boiling H_2O. (Ouvrard, A. ch. (6) **16.** 289.)

$Fe_2O_3, K_2O, 2P_2O_5$. Insol. in H_2O; very sl. attacked by acids. (Ouvrard.)

Ferric silver *meta***phosphate,** $2Fe_2O_3, 2Ag_2O, 5P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 1142.)

Ferric sodium phosphate, $2Fe_2O_3, 3Na_2O, 3P_2O_5$.

Decomp. by H_2O. (Ouvrard.)

Ferric sodium *pyro***phosphate,** $Fe_4(P_2O_7)_3$, $2Na_4P_2O_7+7H_2O$.

Slowly but completely sol. in H_2O. Pptd. by alcohol. (Milck, J. B. **1865.** 263.)

Very sol. in H_2O. (Fleitmann and Henneberg.)

+5, and $6H_2O$. Easily sol. in H_2O, especially if warm. (Pahl, J. B. **1873.** 229.)

$FeNaP_2O_7$. Insol. in H_2O, dil. HCl, or HNO_3+Aq; sl. sol. in conc. HCl + Aq; decomp. by conc. hot H_2SO_4 without solution. (Jörgensen, J. pr. (2) **16.** 342.)

$Fe_4(P_2O_7)_3, 5Na_4P_2O_7+7H_2O$. (Pahl, J. B. **1873.** 229.)

Ferric phosphate sulphate, $3Fe_2(PO_4)_2$, $2Fe_2(SO_4)_3$, $2Fe_2O_6H_6$.

Min. *Diadochite.*

Lanthanum *meta***phosphate,** $La_2(PO_3)_6$.

Precipitate. (Frerichs and Smith.)

$La_2O_3, 5P_2O_5$. Insol. in H_2O, dil., or conc. acids. (Johnsson, B. **22.** 976.)

Lanthanum *ortho*phosphate, $LaPO_4$.

Precipitate. (Hermann.)

Insol. in H_2O and acids. (Ouvrard, C. R. **107**. 37.)

Lanthanum hydrogen phosphate, $La_2H_3(PO_4)_3$.

Precipitate. (Frerichs, B. **7**. 799.)

Existence is doubtful. (Cleve, B. **11**. 910.)

Lanthanum phosphate, acid, La_2O_3, $2P_2O_5$.

Precipitate. (Hermann.)

Lanthanum *pyro*phosphate, $LaHP_2O_7+3H_2O$.

(Cleve.)

$La_2H_6(P_2O_7)_3$. Precipitate. (Frerichs and Smith.)

Does not exist. (Cleve.)

Lanthanum potassium *ortho*phosphate, $2La_2O_3$, $3K_2O$, $3P_2O_5=2LaPO_4$, K_3PO_4.

Insol. in H_2O. (Ouvrard, C. R. **107**. 37.)

Lanthanum sodium *ortho*phosphate, La_2O_3, $3Na_2O$, $2P_2O_5$.

Insol. in H_2O. (Ouvrard.)

Lanthanum sodium *pyro*phosphate, $LaNaP_2O_7$.

Insol. in acetic, and dil. cold mineral acids. Sol. in warm dil. acids. (Wallroth.)

Lead *dimeta*phosphate, PbP_2O_6.

Ppt. Almost insol. in H_2O. Sol. in HNO_3+Aq. (Fleitmann, Pogg. **78**. 253.)

Lead *trimeta*phosphate, $Pb_3(P_3O_9)_2+3H_2O$.

Nearly insol. in H_2O. Less sol. in H_2O than the corresponding Ag salt. (Fleitmann and Henneberg, A. **65**. 304.)

Most insol. of the *trimeta*phosphates. (Lindbom, Acta Lund. **1873**. 12.)

Anhydrous salt is insol. in H_2O; easily sol. in HNO_3+Aq. (Lindbom.)

Lead *tetrameta*phosphate, $Pb_2P_4O_{12}$.

Insol. in H_2O.

More easily decomp. by acids than the other insol. metaphosphates. Easily decomp. by alkali hydrosulphides + Aq in the cold. (Fleitmann, Pogg. **78**. 353.)

Lead *hexameta*phosphate, $Pb_3P_6O_{18}$.

Nearly insol. in H_2O; sol. in acids. (Lüdert, Z. anorg. **5**. 15.)

Lead *ortho*phosphate, basic, $4PbO$, P_2O_5.

(Gerhardt, A. **72**. 85.)

Lead *ortho*phosphate, $Pb_3(PO_4)_2$.

Insol. in H_2O; sol. in HNO_3+Aq. Insol. in $HC_2H_3O_2+Aq$.

Sol. in 782·9 pts. $HC_2H_3O_2+Aq$ containing 38·94 pts. pure $HC_2H_3O_2$. (Bertrand, Monit. Scient. (3) **10**. 477.)

Sol. in $KOH+Aq$. Insol. in NH_4OH+Aq.

Lead hydrogen phosphate, $PbHPO_4$.

Insol. in H_2O. Decomp. by H_2SO_4, or $HCl+Aq$. Sol. in HNO_3, or in KOH or $NaOH+Aq$. Insol. in $HC_2H_3O_2+Aq$. Sol. in cold NH_4Cl+Aq (Brett), from which it can be completely precipitated by a great excess of NH_4OH+Aq.

More sol. in $NH_4C_2H_3O_2+Aq$ at 18·8-25° than in pure H_2O. (Wappen.)

Sol. in sat. $NaCl+Aq$, but less than $PbSO_4$. (Becquerel, C. R. **20**. 1524.)

Insol. in Pb salts + Aq.

Not pptd. in presence of Na citrate (Spiller.)

Lead *pyro*phosphate, $Pb_2P_2O_7+H_2O$.

Insol. in H_2O. Sol. in HNO_3, or $KOH+Aq$. Insol. in NH_4OH+Aq, $HC_2H_3O_2$, or SO_2+Aq. (Schwarzenberg, A. **65**. 133.) Sol. in $Na_4P_2O_7+Aq$. (Stromeyer.)

Lead potassium phosphate, $PbKPO_4$.

Decomp. by hot H_2O. (Ouvrard, C. R. **110**. 1333.)

Lead sodium phosphate, $PbNaPO_4$.

Very sol. in dil. acids. (Ouvrard, C. R. **110**. 1333.)

$10PbO$, $8Na_2O$, $9P_2O_5$. (Ouvrard.)

Lead sodium *pyro*phosphate, $PbNa_2P_2O_7$.

Insol. in hot H_2O. (Gerhardt, A. ch. (3) **22**. 506.)

Lead phosphate chloride, $2PbHPO_4$, $PbCl_2$.

Insol. in boiling H_2O; sol. in dil. HNO_3+Aq. (Gerhardt, A. ch. (3) **22**. 505.)

$2Pb_3(PO_4)_2$, $PbCl_2$. Ppt. (Heintz, Pogg. **73**. 119.)

$3Pb_3(PO_4)_2$, $PbCl_2$. Min. *Pyromorphite*. Sol. in HNO_3, and $KOH+Aq$.

Sl. sol. in cold citric acid + Aq. (Bolton, C. N. **37**. 14.)

$+H_2O$. Insol. in H_2O. Sol. in dil. HNO_3+Aq. (Heintz.)

Lithium *ortho*phosphate, Li_3PO_4.

Very slightly sol. in H_2O.

Sol. in 2539 pts. pure H_2O and 3920 pts. ammoniacal H_2O; much more readily in H_2O containing NH_4 salts. Easily sol. in $HCl+Aq$ or HNO_3+Aq. (Mayer, A. **98**. 193.) Easily sol. in carbonic acid water. (Troost.) Sol. in dil. acids or acetic acid. (de Schulten, Bull. Soc. (3) **1**. 479.)

$+\frac{1}{2}H_2O$, or H_2O.

Lithium hydrogen phosphate, Li_2HPO_4.

Nearly insol. in H_2O. (Gmelin.) Sol. in 833 pts. H_2O at 12°. (Rammelsberg.)

$Li_5H(PO_4)_2+H_2O$. Sol. in 200 pts. H_2O. (Rammelsberg.)

Lithium *di*hydrogen phosphate, LiH_2PO_4.

Deliquescent, and very sol. in H_2O. (Rammelsberg.)

***Hepta*lithium *di*hydrogen phosphate,** $Li_7H_2(PO_4)_3$.

$+1H_2O$, or $2H_2O$. Sol. in H_2O. (Rammelsberg.)

Lithium *penta*hydrogen phosphate, $LiH_5(PO_4)_2+H_2O$.

Deliquescent, and sol. in H_2O.

Lithium *pyro*phosphate, $Li_4P_2O_7+2H_2O$.

(Rammelsberg, B. A. B. **1883**. 21.)

Lithium manganous phosphate, Li_3PO_4, $Mn_3(PO_4)_2$.

Min. *Lithiophilite.*

Lithium sodium phosphate, $3Li_2O$, Na_2O, P_2O_5.

Insol. in H_2O. Sol. in dil. acids. (Ouvrard, C. R. **110**. 1333.)

$2Li_2O$, Na_2O, $2P_2O_5$. As above. (Ouvrard.)

Magnesium *meta*phosphate, $Mg(PO_3)_2$.

Insol. in H_2O or dil. acids, but sol. in H_2SO_4 + Aq. (Maddrell, A. **61**. 62.)

Not decomp. by very long digestion with alkali carbonates, or orthophosphates + Aq. (Fleitmann.)

Magnesium *dimeta*phosphate, $Mg_2(P_2O_6)_2 + 9H_2O$.

Insol. in H_2O; decomp. by acids. (Fleitmann, Pogg. **78**. 259.)

Magnesium *trimeta*phosphate, $Mg_3(P_3O_9)_2$.

Sl. sol. in cold H_2O, more easily in hot H_2O. When ignited, insol. in boiling HCl + Aq. (Lindbom.)

Cryst. with 12, or $15H_2O$.

Magnesium *ortho*phosphate, $Mg_3(PO_4)_2$, and + 5, or $7H_2O$.

1 litre H_2O dissolves 0·1 g. ignited $Mg_3(PO_4)_2$ in 7 days, but 0·205 g. if freshly precipitated. (Völcker, J. B. **1862**. 131.)

1 l. H_2O with 2 g. NaCl dissolves 75·8 mg.; 1 l. H_2O with 3 g. $NaNO_3$ dissolves 61·9 mg. $Mg_3(PO_4)_2$. (Liebig, A. **106**. 185.)

Easily sol. in acids, except in acetic acid. (Schaffner, A. **50**. 145.)

Easily sol. in H_2O in presence of alkali salts.

$+6\frac{1}{2}H_2O$. Sol. in 30 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr. = 1·09) dissolves 37·5 % of the P_2O_5. (Erlenmeyer, B. **14**. 1253.)

$+20H_2O$. Sol. in 10 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr. = 1·09) dissolves 23·2 % of the P_2O_5; sol. in 15 min. in $\frac{1}{4}$ % citric acid + Aq. (Erlenmeyer, *l.c.*)

Magnesium hydrogen phosphate, $MgHPO_4 + 7H_2O$.

Sol. in 322 pts. cold H_2O in several days. If heated to 40° becomes milky, and separates a precipitate out at 100° of same salt, so that solution at 100° contains only 1 pt. salt in 498 pts. H_2O. Much more sol. in H_2O containing traces of acids, even dil. oxalic or acetic acids, (Graham, Phil. Mag. Ann. **2**. 20.) Easily sol. in H_2SO_3 + Aq. (Gerland, J. pr. (2) **4**. 127.)

Sol. in aqueous solution of Mg salts, but insol. in Na_2HPO_4 + Aq. (Rose.) Sol. in sodium citrate + Aq. (Spiller.) When freshly precipitated it is sol. in hot NH_4Cl + Aq, and NH_4OH + Aq does not completely reprecipitate it; less sol. in NH_4NO_3 + Aq. (Brett, Phil. Mag. (3) **10**. 96.) Insol. in alcohol. (Berzelius.)

$+\frac{1}{2}H_2O$. (Debray.)

$+H_2O$. Easily sol. in dil. acids. (de Schulten, C. R. **100**. 263.)

$+3H_2O$. Sl. sol. in H_2O, easily in acids. (Stoklasa, Z. anorg. **3**. 67.)

$+4\frac{1}{2}H_2O$. (Bergmann.)

$+6H_2O$. (Debray.)

Magnesium *tetra*hydrogen phosphate, $MgH_4(PO_4)_2$.

Not hygroscopic. Sol. in 5 pts. H_2O without decomp. (Stoklasa, Z. anorg. **3**. 67.)

$+2H_2O$. Not hygroscopic. Sol. in H_2O without decomp. (Stoklasa, Z. anorg. **1**. 307.)

Decomp. by alcohol into $MgHPO_4 + 3H_2O$.

Magnesium *pyro*phosphate, $Mg_2P_2O_7$.

Nearly insol. in H_2O; readily sol. in HCl or HNO_3 + Aq. (Fresenius.)

$+3H_2O$. Sl. sol. in H_2O, easily in HCl or HNO_3 + Aq; sol. in H_2SO_3 + Aq, and $Na_4P_2O_7$ + Aq. (Schwarzenberg.)

Sol. in $MgSO_4$ + Aq, and $(NH_4)_2CO_3$ + Aq.

Magnesium *tetra*phosphate, $Mg_3P_4O_{13}$.

Insol. in H_2O. (Fleitmann and Henneberg, A. **65**. 331.)

Magnesium potassium phosphate, $MgKPO_4$.

Sl. sol. in H_2O. Decomp. by H_2O. Easily sol. in acids.

$+6H_2O$.

$2MgO$, K_2O, $3P_2O_5$. Insol. in H_2O; sol. in dil. HCl + Aq. (Ouvrard, C. R. **106**. 1729.)

$Mg_2HK(PO_4)_2 + 15H_2O$. (Haushofer.)

Magnesium sodium *meta*phosphate, $3MgO$, Na_2O, $4P_2O_5$.

Insol. in H_2O or H_3PO_4 + Aq. Scarcely sol. in HCl + Aq, or aqua regia. Not decomp. by $(NH_4)_2CO_3$ + Aq. Sol. in conc. H_2SO_4. (Maddrell, A. **61**. 53.)

Magnesium sodium *trimeta*phosphate, $MgNa_4(P_3O_9)_2 + 5H_2O$.

Sl. sol. in H_2O. After ignition is insol. in H_2O. (Lindbom.)

Magnesium sodium phosphate, $10MgO$, $8Na_2O$, $9P_2O_5$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106**. 1729.)

Magnesium sodium *ortho*phosphate, $MgNaPO_4$.

Insol. in H_2O. (Rose.)

$+9H_2O$. (Schoecker and Violet, A. **140**. 232.)

MgO, $2Na_2O$, P_2O_5. Insol. in H_2O. (Ouvrard.)

$3MgO$, $3Na_2O$, $2P_2O_5$. Insol. in H_2O. (Ouvrard.)

Magnesium sodium *pyro*phosphate, basic (?).

Precipitate; sl. sol. in H_2O. Easily in HCl + Aq, HNO_3 + Aq, and $Na_4P_2O_7$ + Aq. (Baer, Pogg. **75**. 168.)

Sol. in $(NH_4)_2CO_3$ + Aq, and in $MgSO_4$ + Aq. Insol. in alcohol.

Magnesium phosphate chloride, $Mg_3(PO_4)_2$, $MgCl_2$.

(Deville and Caron, A. ch. (3) **67**. 455.)

Magnesium *pyro*phosphate nitrogen *di*oxide, $Mg_2P_2O_7, H_2O, NO_2$.

Scarcely sol. in water. (Luck, Z. anal. **13.** 255.)

Magnesium phosphate fluoride, $Mg_3(PO_4)_2, MgF_2$.

Min. *Wagnerite.* Slowly sol. in hot HNO_3, and H_2SO_4.

Magnesium phosphate calcium fluoride, $2Mg_3(PO_4)_2, CaF_2$.

Min. *Kjerulfite.*

Manganous *dimeta*phosphate, $Mn_2(P_2O_6)_2$.

Anhydrous. Insol. in H_2O and dil. acids. (Fleitmann.) Sol. in conc. H_2SO_4. (Maddrell.) Scarcely attacked by warm Na_2S+Aq, and not much more by $(NH_4)_2S+Aq$. Decomp. by Na_2CO_3+Aq.

$+8H_2O$. Insol. in H_2O and dil. acids. (Fleitmann, Pogg. **78.** 257.)

Manganous *trimeta*phosphate, $Mn_3(P_3O_9)_2+11H_2O$.

Difficultly sol. in cold or warm H_2O. More easily sol. in cold, very easily in warm $HCl+Aq$. When ignited, is insol. in acids, even aqua regia. (Lindbom.)

Manganous *hexameta*phosphate.

Sol. in sodium hexametaphosphate + Aq. (Rose, Pogg. **76.** 4.)

$Mn_3P_6O_{18}$. Nearly insol. in H_2O; easily sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Manganic *meta*phosphate, $Mn(PO_3)_3$.

Insol. in H_2O or acids; decomp. by alkalies. (Schjerning, J. pr. (2) **45.** 515.)

$+H_2O$. Insol. in H_2O or acids, except $HCl+Aq$. Sl. decomp. by boiling with H_2SO_4. (Hermann, Pogg. **74.** 303.)

Manganous *ortho*phosphate, $Mn_3(PO_4)_2$.

$+H_2O$. (Debray.)

$+3H_2O$. Sol. in 20 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr. = 1·09) dissolves 30·2 % of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

$+4\frac{1}{2}$-$5\frac{1}{2}H_2O$. Efflorescent. (Erlenmeyer and Heinrich, A. **190.** 208.)

$+7H_2O$. Very sl. sol. in H_2O. (Berzelius.) Easily sol. in mineral acids; sol. in $HC_2H_3O_2+Aq$.

Easily sol. in SO_2+Aq. (Gerland, J. pr. (2) **4.** 97.)

Somewhat sol. in boiling $(NH_4)_2CO_3+Aq$, but deposited on cooling. (Berzelius.) Partly sol. in cold NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sol. in cold or hot solutions of ammonium sulphate or succinate. (Wittstein.)

Sl. sol. in Mn salts + Aq. (Rose, Pogg. **76.** 25.)

Insol. in alcohol.

Sol. in 10 min. in diammonium citrate + Aq (sp. gr. = 1·09); triammonium citrate + Aq (sp. gr. = 1·09) dissolves 53 % of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Manganous *di*hydrogen *ortho*phosphate, $MnHPO_4+3H_2O$.

Sl. sol. in H_2O. Solution decomp. at 100°. (Debray.) Slowly decomp. by cold H_2O into $Mn_3(PO_4)_2$. (Erlenmeyer and Heinrich, A. **190.** 208.)

Easily sol. in H_2SO_3+Aq. (Gerland.)

Sl. sol. in $HC_2H_3O_2$, easily in conc. mineral acids. (Heintz.) Sol. in $(NH_4)_2CO_3+Aq$, from which it is repptd. on boiling. Decomp. by boiling $KOH+Aq$.

Insol. in alcohol.

Manganous *tetra*hydrogen phosphate, $MnH_4(PO_4)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O, with decomp. to $MnHPO_4$. (Erlenmeyer and Heinrich, A. **190.** 208.)

Not decomp. by H_2O. (Otto, C. C. **1887.** 1563.)

Alcohol dissolves out H_3PO_4. (Heintz.)

***Penta*manganous *di*hydrogen phosphate,** $Mn_5H_2(PO_4)_4+4H_2O$.

Not decomp. by boiling H_2O. (Erlenmeyer and Heinrich, A. **190.** 208.)

Manganic *ortho*phosphate, basic, $Mn_2P_2O_9+H_2O$.

Sl. sol. in H_2O.

Manganic *ortho*phosphate, $MnPO_4+H_2O$.

Sol. in acids. (Christensen, J. pr. (2) **28.** 1.)

Manganous *pyro*phosphate, $Mn_2P_2O_7$.

Anhydrous. (Lewis, Sill. Am. J. (3) **14.** 281.)

$+H_2O$.

$+3H_2O$. Insol. in H_2O. Insol. in $MnSO_4+Aq$, but sol. in $Na_4P_2O_7+Aq$. (Rose.)

Difficultly sol. in $Na_4P_2O_7+Aq$, but easily sol. in $K_4P_2O_7+Aq$. (Pahl.) Decomp. by $KOH+Aq$. Sol. in H_2SO_3+Aq. (Schwarzenberg.)

Manganous hydrogen *pyro*phosphate, $MnH_2P_2O_7+4H_2O$.

Sol. in H_2O. (Pahl.)

Manganic *pyro*phosphate, $MnHP_2O_7$.

Insol. in H_2O; very sl. attacked by dil. $HCl+Aq$, easily by conc. Sol. in conc. H_2SO_4. (Schjerning, J. pr. (2) **45.** 515.)

Manganous potassium phosphate, $MnK_2P_2O_7$.

Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$+8H_2O$. Sl. sol. in H_2O. (Pahl.)

$Mn_2P_2O_7, 2K_4P_2O_7+10H_2O$. Difficultly sol. in H_2O. (Pahl.)

$MnKPO_4$. Insol. in H_2O; easily sol. in dil. acids. (Ouvrard.)

Manganic potassium *pyro*phosphate, $MnKP_2O_7$.

Insol. in H_2O. Decomp. by acids and bases. (Schjerning.)

Manganous sodium *trimeta*phosphate.

Sol. in H_2O. (Fleitmann and Henneberg.)

$MnNa(PO_3)_3$. Insol. in H_2O, dil. acids, or alkalies. (Schjerning, J. pr. (2) **45.** 515.)

Manganous sodium phosphate, $MnNaPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **106.** 1729.)

$MnO, 2Na_2O, P_2O_5$. As above.

Manganous sodium *pyro*phosphate, $MnNa_2P_2O_7$.

Insol. in H_2O; easily sol. in dil. acids. (Wallroth.)

$+4\frac{1}{2}H_2O$. Very sl. sol. in H_2O. (Pahl.)

$3Mn_2P_2O_7, 2Na_4P_2O_7+24H_2O$. Very sl. sol. in H_2O. (Pahl.)

Manganic sodium *pyro*phosphate, $MnNaP_2O_7+H_2O$.

(Christensen, J. pr. (2) **28.** 1.)

Manganous phosphate chloride, $Mn_3(PO_4)_2, MnCl_2$.

Insol. in H_2O. (Deville and Caron, A. ch. (3) **67.** 459.)

$3Mn_3(PO_4)_2, MnCl_2$. Insol. in H_2O. (Deville and Caron.)

Mercurous *hexameta*phosphate (?).

Ppt. Sol. in sodium hexametaphosphate +Aq. (Rose.)

$Hg_6P_6O_{18}$. Insol. in H_2O; very sl. sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Mercuric *hexameta*phosphate, $Hg_3P_6O_{18}$.

Moderately sol. in H_2O when freshly pptd. More sol. in acids than the mercurous salt. (Lüdert.)

Mercurous *ortho*phosphate, $(Hg_3)_2(PO_4)_2$.

Ppt. Decomp. by boiling with H_2O. (Gerhardt.)

Sol. in HNO_3+Aq. Sol. in $Hg_2(NO_3)_2+Aq$. Insol. in H_3PO_4+Aq.

Mercuric *ortho*phosphate, $Hg_3(PO_4)_2$.

Insol. in H_2O. Sl. sol. in hot H_2O, crystallising out on cooling. (Haack, A. **262.** 185.) Slowly sol. in cold dil., quickly in hot dil. or cold conc. $HCl+Aq$. Less easily sol. in HNO_3+Aq. Sol. in H_3PO_4+Aq. (Berzelius.) Insol. in H_3PO_4+Aq. (Haack.) Decomp. by $NaCl+Aq$ into insol. $HgCl_2, 3HgO$, but sol. in $NaCl+Aq$, containing HNO_3. (Haack.)

Sol. in 6 pts. NH_4Cl in aqueous solution by heating. (Trommsdorff.)

Sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Wittstein.)

Insol. in alcohol.

Mercuromercuric *ortho*phosphate, $7Hg_2O, 14HgO, 2P_2O_5+20H_2O$.

(Brooks, Pogg. **66.** 63.)

Mercurous *pyro*phosphate, $Hg_4P_2O_7+H_2O$.

Sol. in $Na_4P_2O_7+Aq$, when recently pptd. Insol. in $Na_4P_2O_7+Aq$, when heated to 100°. Sol. in HNO_3+Aq. Decomp. by $HCl+Aq$. (Schwarzenberg, A. **65.** 133.)

Mercuric *pyro*phosphate, $Hg_2P_2O_7$.

Sol. in acids; insol. in $Na_4P_2O_7+Aq$, after being heated to 100°. Sol. in $NaCl+Aq$; quickly decomp. by $NaOH+Aq$, and Na_2HPO_4+Aq.

Sol. in 6 pts. NH_4Cl+Aq. (Trommsdorff.)

Sol. in NH_4NO_3, $(NH_4)_2SO_4$, and $(NH_4)_2CO_3+Aq$; also in $KI+Aq$.

Molybdenum phosphate, $Mo_2(PO_4)_2$ (?).

Insol. in H_2O. Sol. in $MoCl_2+Aq$.

Nickel *dimeta*phosphate, NiP_2O_6.

Insol. in H_2O or dil. acids. Sol. in conc. H_2SO_4. Not decomp. by boiling alkali carbonates or sulphides +Aq. (Maddrell, A. **61.** 58.)

Nickel *ortho*phosphate, $Ni_3(PO_4)_2+7H_2O$.

Insol. in H_2O. Sol. in acids. (Rammelsberg, Pogg. **68.** 383.)

Sol. in Ni salts+Aq. (Rose, Pogg. **76.** 25.)

Insol. in Na_2HPO_4+Aq. (Tupputi, **1811.**)

Very sl. sol. in hot $(NH_4)_2HPO_4+Aq$.

Nickel *pyro*phosphate, $Ni_2P_2O_7+6H_2O$.

Insol. in H_2O; sol. in mineral acids, $Na_4P_2O_7+Aq$, and NH_4OH+Aq. Not pptd. from $Ni_2P_2O_7+Aq$ by alcohol. (Schwarzenberg, A. **65.** 158.)

Nickel potassium phosphate, $NiKPO_4$.

Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$3NiO, 3K_2O, 2P_2O_5$. As above.

Nickel sodium *meta*phosphate, $3Ni(PO_3)_2, NaPO_3$.

Insol. in H_2O and dil. acids. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 56.)

$NiNa_4(PO_3)_3+8H_2O$. Easily sol. in H_2O. (Lindbom.)

Nickel sodium *ortho*phosphate, $NiNaPO_4+7H_2O$.

Ppt. (Debray, C. R. **59.** 40.)

$NiO, 2Na_2O, P_2O_5$. Insol. in H_2O. Easily sol. in dil. acids. (Ouvrard.)

Nickel sodium *pyro*phosphate, $Ni_{10}Na_{16}(P_2O_7)_9$.

Insol. in H_2O. Moderately sol. in acids. (Wallroth.)

Osmium phosphate (?).

Sl. sol. in H_2O; sol. in HNO_3+Aq. (Berzelius.)

Palladium *ortho*phosphate (?).

Ppt.

Phosphorous phosphate, $4P_4O, 3P_2O_5$ (?).

Decomp. spontaneously. Sol. in H_2O and alcohol when fresh; insol. in ether. (le Verrier, A. **27.** 167; Reinitzer, B. **14.** 1884.)

Potassium *monometa*phosphate, KPO_3.

Nearly insol. in H_2O; sol. in weak acids, even in acetic acid. (Maddrell, A. **61.** 62.)

Insol. in H_2O and weak acids. (Fleitmann, Pogg. **78.** 250.)

Potassium *dimeta*phosphate, $K_2P_2O_6+H_2O$.

Sol. in 1·2 pts. cold H_2O, but not more in hot H_2O. (Fleitmann, Pogg. **78.** 250.)

Potassium *trimeta*phosphate, $K_3P_3O_9$.

Very sol. in cold H_2O before it is fused. (Lindbom, Acta Lund. **1873.** 14.)

Potassium *ortho*phosphate, K_3PO_4.

Not deliquescent. Very sol. in H_2O. (Graham, Pogg. **32**. 47.)

Very sl. sol. in cold, easily in hot H_2O. (Darracq.)

Insol. in alcohol.

Potassium hydrogen phosphate, K_2HPO_4.

Deliquescent. Very sol. in H_2O and alcohol.

Potassium *di*hydrogen phosphate, KH_2PO_4.

Deliquescent. Easily sol. in H_2O. (Vauquelin, A. ch. **74**. 96.)

Sol. in 20 % $KC_2H_3O_2$ + Aq. (Stromeyer.)

Sp. gr. of KH_2PO_4 + Aq at 18° containing :

5	10	15 % KH_2PO_4.
1·0341	1·0691	1·1092

(Kohlrausch, W. Ann. **1879**. 1.)

Melts in crystal H_2O at 96°. (Tilden, Chem. Soc. **45**. 409.)

Insol. in alcohol.

Potassium *pyro*phosphate, $K_4P_2O_7 + 3H_2O$.

Very deliquescent, and sol. in H_2O.

Precipitated from aqueous solution by alcohol. (Schwarzenberg, A. **65**. 136.)

Potassium hydrogen *pyro*phosphate, $K_2H_2P_2O_7$.

Very deliquescent, and sol. in H_2O. Insol. in alcohol. (Schwarzenberg.)

Potassium sodium *dimeta*phosphate, $KNaP_2O_6 + H_2O$.

Sol. in 24 pts. H_2O. (Fleitmann, Pogg. **78**. 339.)

Potassium sodium phosphate, $KNaHPO_4 + 7H_2O$.

Not efflorescent. Sol. in H_2O.

***Tri*potassium *tri*sodium *hexa*hydrogen phosphate,** $H_6Na_3K_3(PO_4)_4 + 22H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **93**. 388.)

Potassium sodium *pyro*phosphate, $K_2Na_2P_2O_7 + 12H_2O$.

Sol. in H_2O. (Schwarzenberg, A. **65**. 140.)

Potassium strontium phosphate, $KSrPO_4$.

Insol. in H_2O ; sol. in dil. acids. (Grandeau, A. ch. (6) **8**. 193.)

Potassium strontium *pyro*phosphate, $K_2SrP_2O_7$.

Insol. in H_2O ; sol. in dil. acids. (Ouvrard, C. R. **106**. 1599.)

Potassium thorium phosphate, K_2O, $4ThO_2$, $3P_2O_5$.

Insol. in HCl, HNO_3, or aqua regia. (Troost and Ouvrard, C. R. **102**. 1422.)

K_2O, ThO_2, P_2O_5. Insol. in H_2O ; sol. in HNO_3 + Aq. (Troost and Ouvrard.)

$6K_2O$, $3ThO_2$, $4P_2O_5$. Sol. in acids. (Troost and Ouvrard.)

Potassium stannic phosphate, K_2O, $4SnO_2$, $3P_2O_5$.

(Ouvrard, C. R. **111**. 177.)

K_2O, $2SnO_2$, P_2O_5. (Ouvrard.)

Potassium titanium phosphate, K_2O, $4TiO_2$, $3P_2O_5$.

(Ouvrard, C. R. **111**. 177.)

K_2O, $2TiO_2$, P_2O_5. (Ouvrard.)

Potassium uranyl phosphate, K_2O, UO_3, P_2O_5.

(Ouvrard, C. R. **110**. 1333.)

$2K_2O$, UO_3, P_2O_5. (Ouvrard.)

K_2O, $2UO_3$, P_2O_5. (Ouvrard.)

Potassium vanadium phosphate, $2(VO_2)H_2PO_4 + K_2O$, $V_2O_5 + 5H_2O$, and $2K_2HPO_4$, $5K_2O$, $12V_2O_5$.

See **Phosphovanadate, potassium.**

Potassium yttrium phosphate, $3K_2O$, Y_2O_3, $2P_2O_5$.

K_2O, Y_2O_3, $2P_2O_5$.

$3K_2O$, $5Y_2O_3$, $6P_2O_5$. (Duboin, C. R. **107**. 622.)

Potassium zinc phosphate, $KZnPO_4$.

Insol. in H_2O. Sol. in dil. acids. (Ouvrard, C. R. **106**. 1729.)

$K_2ZnP_2O_7$. As above.

Potassium zirconium phosphate, K_2O, $4ZrO_2$, $3P_2O_5$.

Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. **102**. 1422.)

K_2O, ZrO_2, P_2O_5. Insol. in H_2O, HNO_3, HCl, or aqua regia. Sol. in hot conc. H_2SO_4. (Troost and Ouvrard.)

Potassium hydrogen phosphate sulphate, KH_2PO_4, $KHSO_4$.

Decomp. by H_2O and alcohol. (Jacquelain.)

Rhodium phosphate, basic, $4Rh_2O_3$, $3P_2O_5 + 32H_2O$.

Insol. in H_2O or acids. (Claus.)

Rh_2O_3, $P_2O_5 + 6H_2O = RhPO_4 + 3H_2O$. Sol. in H_2O. (Claus.)

Samarium *anhydrometa*phosphate, Sm_2O_3, $5P_2O_5$.

Insol. in H_2O or HNO_3 + Aq. (Cleve.)

Samarium *ortho*phosphate, $SmPO_4$.

Scarcely attacked by boiling HNO_3 + Aq. (Cleve.)

$+2H_2O$.

Samarium *pyro*phosphate, $SmHP_2O_7 + 1\frac{1}{2}H_2O$. (Cleve.)

Silicon phosphate.

See **Silicophosphoric acid.**

Silver *dimeta*phosphate, $Ag_2P_2O_6$.

Very sl. sol. in H_2O. (Fleitmann, Pogg. **78**. 253.)

Sol. in cold aniline metaphosphate + Aq. (Nicholson.)

Silver *trimeta*phosphate, $Ag_3P_3O_9$.

Sol. in 60 pts. cold H_2O. Can be crystallised from conc. HNO_3 + Aq. (Fleitmann and Henneberg.)

$+H_2O$. (Lindbom.)

Silver *hexameta*phosphate, $Ag_6P_6O_{18}$.

Insol. in H_2O. Sol. in HNO_3 or NH_4OH + Aq, and in a large excess of sodium hexametaphosphate + Aq. (Rose.)

Easily decomp. by Na_2S + Aq.

Decomp. gradually by hot H_2O into $Ag_6P_4O_{13}$.

When freshly pptd. easily sol. in H_2O. Easily sol. in dil. acids. (Lüdert, Z. anorg. **5.** 15.)

Silver *ortho*phosphate, Ag_3PO_4.

Insol. in H_2O. Sol. in H_3PO_4, HNO_3, or $HC_2H_3O_2$ + Aq, in NH_4OH or $(NH_4)_2CO_3$ + Aq. Less easily in ammonium nitrate or succinate, and incompletely in $(NH_4)_2SO_4$ + Aq. (Lassaigne, J. Pharm. (3) **16.** 289.)

Insol. in Na_2HPO_4 + Aq. (Stromeyer.)

Not pptd. in presence of Na citrate. (Spiller.)

If 1 mol. Ag_3PO_4 is boiled with 1 mol. Na_2CO_3, 44 % of it is decomp. (Malaguti.)

Readily sol. in soluble hyposulphites + Aq with decomp. (Herschel.)

Insol. in Ag salts + Aq. (Rose.)

Silver hydrogen phosphate, Ag_2HPO_4.

Decomp. by H_2O or alcohol into H_3PO_4 and Ag_3PO_4. (Joly, C. R. **103.** 1071.)

Sol. in H_3PO_4 + Aq; insol. in ether. (Schwarzenberg, A. **65.** 162.)

Silver *pyro*phosphate, $Ag_4P_2O_7$.

Insol. in hot or cold H_2O. Sol. in cold HNO_3 + Aq without decomp. Decomp. by hot HNO_3 or H_2SO_4 into orthophosphate. Decomp. by HCl + Aq into AgCl and H_3PO_4. Insol. in $HC_2H_3O_2$ + Aq. Sol. in NH_4OH + Aq without decomp. (Stromeyer, Schw. J. **58.** 126.)

Insol. in $Na_4P_2O_7$ + Aq. Very sl. sol. in $AgNO_3$ + Aq. (Schwarzenberg, A. **65.** 161.)

Not completely insol. in $Na_4P_2O_7$ + Aq. (Rose.)

Silver hydrogen *pyro*phosphate, $Ag_2H_2P_2O_7$.

Decomp. by H_2O into $Ag_4P_2O_7$. (Hurtzig and Geuther, A. **111.** 160.)

Silver hydrogen *pyro*phosphate *meta*phosphate, $2Ag_2HP_2O_7$, HPO_3.

Decomp. by H_2O. Easily sol. in HNO_3 + Aq. (H. and G.)

Silver *tetra*phosphate, $6Ag_2O$, $4P_2O_5$ = $Ag_6P_4O_{13}$.

Insol. in, but gradually decomp. by boiling H_2O. (Berzelius.)

Sol. in large excess of the corresponding Na salt + Aq.

Silver *deka*phosphate, $Ag_{12}P_{10}O_{31}$.

Easily sol. in sodium dekaphosphate + Aq. (Fleitmann and Henneberg, A. **65.** 330.)

Silver sodium *dimeta*phosphate, $AgNaP_2O_6$.

Sol. in H_2O. (Fleitmann and Henneberg, Pogg. **65.** 310.)

Silver sodium *pyro*phosphate, $6Ag_4P_2O_7$, $Na_4P_2O_7 + 4H_2O$.

Not completely sol. in $Na_4P_2O_7$ + Aq. Easily sol. in HNO_3 + Aq. (Baer, Pogg. **75.** 152.)

Easily sol. in H_2O. (Stromeyer.)

Silver phosphate ammonia, Ag_3PO_4, $4NH_3$.

(Widmann, B. **17.** 2284.)

Sodium *monometa*phosphate, $NaPO_3$.

Insol. in H_2O. Sol. in dil. and conc. acids. (Maddrell, A. **61.** 63.)

Insol. in acids. (Graham.)

Gradually decomp. by alkalies.

Sodium *dimeta*phosphate, $Na_2P_2O_6 + 2H_2O$.

Deliquescent. Sol. in 7·2 pts. of cold or hot H_2O. Very sol. in conc. HCl + Aq. Sol. in NaOH + Aq. Insol. in strong, very sl. sol. in dilute alcohol. (Fleitmann, Pogg. **78.** 246.)

Sodium *trimeta*phosphate, $Na_3P_3O_9 + 6H_2O$.

Sol. in 4·5 pts. cold H_2O. Insol. in strong, very sl. sol. in dil. alcohol. (Fleitmann and Henneberg, A. **65.** 307.)

Decomp. by boiling H_2O. (Lindbom.)

Sodium *tetrameta*phosphate, $Na_4P_4O_{12}$.

Sol. in H_2O; cryst. with about $4H_2O$. Less sol. in alcohol than in H_2O. (Fleitmann, Pogg. **78.** 854.)

Sodium *hexameta*phosphate, $Na_6P_6O_{18}$.

Deliquescent. Very sol. in H_2O. Insol. in alcohol. (Graham, Pogg. **32.** 56.)

Sodium *ortho*phosphate, $Na_3PO_4 + 12H_2O$.

Not deliquescent in dry air.

100 pts. H_2O dissolve 19·6 pts. crystals at 15·5°. (Graham.)

100 pts. H_2O dissolve 28·3 pts. $Na_3PO_4 + 12H_2O$ at 15°. (Schiff.)

Melts in crystal water at 76·6°. (Graham.)

Sp. gr. of Na_3PO_4 + Aq at 15°.
% = % $Na_3PO_4 + 12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·0043	9	1·0399	17	1·0778
2	1·0086	10	1·0455	18	1·0827
3	1·0130	11	1·0492	19	1·0876
4	1·0174	12	1·0539	20	1·0925
5	1·0218	13	1·0586	21	1·0975
6	1·0263	14	1·0633	22	1·1025
7	1·0308	15	1·0681	23	1·1076
8	1·0353	16	1·0729	24	1·1127

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

$+ 10H_2O$.

Sodium hydrogen phosphate, Na_2HPO_4.

Sol. in H_2O with evolution of heat.

100 pts. H_2O dissolve at t°:

t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4
0	1·55	40	30·88	80	81·29
10	4·10	50	43·31	90	95·02
20	11·08	60	55·29	100	108·20
30	19·95	70	68·72	106·2	114·43

(Poggiale, J. Pharm. (3) **44.** 273.)

100 pts. H_2O at 13° dissolve 3·4 pts. Na_2HPO_4 (Ferein, Ph. Viertelj. **7.** 244); at 15°, 5·9 pts. (Neese); at 16°, 6·3

pts. (Mulder); at 16°, 8·4 pts. (Müller, J. pr. **95.** 52); at 20°, 6·8 pts. (Neese, Russ. Z. Pharm. **1.** 101); at 25°, 12·5 pts. (*ibid*).

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4
0	2·5	35	39·3	69	94·8
1	2·6	36	43·6	70	95·0
2	2·6	37	49·5	71	95·1
3	2·7	38	55·5	72	95·2
4	2·7	39	60·6	73	95·4
5	2·8	40	63·9	74	95·6
6	3·0	41	66·2	75	95·8
7	3·2	42	68·6	76	96·0
8	3·4	43	70·8	77	96·1
9	3·6	44	72·9	78	96·3
10	3·9	45	74·8	79	96·5
11	4·2	46	76·5	80	96·6
12	4·5	47	78·2	81	96·8
13	4·9	48	79·7	82	96·9
14	5·3	49	81·2	83	97·0
15	5·8	50	82·5	84	97·1
16	6·3	51	83·7	85	97·2
17	6·9	52	84·8	86	97·4
18	7·6	53	85·8	87	97·5
19	8·4	54	86·7	88	97·6
20	9·3	55	87·7	89	97·7
21	10·3	56	88·6	90	97·8
22	11·4	57	89·4	91	97·9
23	12·6	58	90·2	92	98·0
24	14·0	59	90·9	93	98·1
25	15·4	60	91·6	94	98·2
26	16·9	61	92·2	95	98·4
27	18·5	62	92·7	96	98·5
28	20·2	63	93·1	97	98·6
29	22·0	64	93·5	98	98·7
30	24·1	65	93·8	99	98·8
31	26·4	66	94·1	105	82·5
32	29·1	67	94·4	105·57	80·7
33	32·1	68	94·6	106·4	79·2
34	35·5	...	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 103.)

$+7H_2O$. Not efflorescent. Sol. in H_2O with absorption of heat.

Sol. in 8 pts. H_2O at 23°. (Neese, J. B. **1863.** 181.)

$+12H_2O$. Efflorescent. Sol. in H_2O with absorption of heat.

14 pts. $Na_2HPO_4+12H_2O$ mixed with 100 pts. H_2O at 10·8° lower the temperature 3·7°. (Rüdorff, B. **2.** 68.)

Sol. in 8·48 pts. H_2O at 17°, or 100 pts. H_2O dissolve 11·8 pts. at 17°, and solution has sp. gr. = 1·0422. (Schiff.)

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Pagens.)

Sol. in 4 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O dissolve 12·735 pts. $Na_2HPO_4+12H_2O$. (Michel and Krafft.)

100 pts. H_2O dissolve 6·5 pts. $Na_2HPO_4+12H_2O$ at 0°; 27·5 pts. at 30°. (Tilden, Chem. Soc. **45.** 409.)

Na_2HPO_4+Aq saturated at 15° has 1·0469 sp. gr. (Michel and Krafft); saturated at 16°, 1·0511 (Stolba).

Sp. gr. of Na_2HPO_4+Aq at 19°.

% $Na_2HPO_4+12H_2O$	Sp. gr.	% $Na_2HPO_4+12H_2O$	Sp. gr.	% $Na_2HPO_4+12H_2O$	Sp. gr.
1	1·0041	5	1·0208	9	1·0376
2	1·0083	6	1·0250	10	1·0418
3	1·0125	7	1·0292	11	1·0460
4	1·0166	8	1·0332	12	1·0503

(Schiff, A. **110.** 70.)

Saturated solution freezes at – 0·45° (Rüdorff, Pogg. **122.** 337), and boils at 105° (Griffiths), 105-106·4° (Mulder), 106·5° (Legrand).

Sat. Na_2HPO_4+Aq boils at 105·5° (Griffiths); at 106·5°, and contains 113·2 pts. Na_2HPO_4 to 100 pts. H_2O (Legrand); forms a crust at 106·4°, and contains 108·8 pts. Na_2HPO_4 to 100 pts. H_2O; highest temp. observed, 106·8°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of Na_2HPO_4+Aq containing pts. Na_2HPO_4 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 450); L = according to Legrand (A. ch. (2) **59.** 426).

B.-pt.	G	L	B.-pt.	G	L
100·5°	8·6	11·0	104°	68·4	76·4
101	17·2	21·0	104·5	76·9	84·2
101·5	25·8	31·0	105	85·3	91·5
102	34·4	40·8	105·5	93·7	98·4
102·5	42·9	50·3	106	102·1	105·0
103	51·4	59·4	106·5	110·5	111·4
103·5	59·9	68·1	106·6	...	112·6

Melts in crystal H_2O at 34·6° (Persoz), 35° (Kopp), 40-41° (Mulder).

Melts in crystal water below 100°, and easily forms supersaturated solutions. (Gay-Lussac.)

Melts in crystal H_2O at 35°. (Tilden, Chem. Soc. **45.** 409.)

Supersaturated solutions are brought to crystallisation by addition of a crystal of $Na_2HPO_4+12H_2O$ or an isomorphous substance as $Na_2HAsO_4+12H_2O$. (Thomson, Chem. Soc. **35.** 200.)

Insol. in alcohol.

Sodium *di*hydrogen phosphate, $NaH_2PO_4+H_2O$.

Very sol. in H_2O. Insol. in alcohol. (Graham.)

$+2H_2O$. Unchanged on air. Very sol. in H_2O, and solubility increases rapidly with the temperature. (Joly and Dufet, C. R. **102.** 1391.)

$+4H_2O$. (J. and D.)

***Tri*sodium *tri*hydrogen phosphate,** $Na_3H_3(PO_4)_2+1\frac{1}{2}H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **93.** 388.)

$+15H_2O$.

Sodium *pyro*phosphate, $Na_4P_2O_7$, and $+10H_2O$.

Less sol. in H_2O than sodium hydrogen phosphate. (Clark, Ed. J. Sci. **7.** 298.)

100 pts. H_2O dissolve (*a*) pts. $Na_4P_2O_7$, (*b*) pts. $Na_4P_2O_7+10H_2O$ at:

	0°	10°	20°	30°	40°	50°
a.	3·16	3·95	6·23	9·95	13·50	17·45
b.	5·41	6·81	10·92	18·11	24·97	33·25

	60°	70°	80°	90°	100°
a.	21·83	25·62	30·04	35·11	40·26
b.	44·07	52·11	63·40	77·47	93·11

(Poggiale.)

Crystallises unchanged from NH_4Cl+Aq (Winkler), or conc. NH_4OH+Aq (Uelsmann.)

Decomp. into orthophosphate by heating with H_2SO_4, HCl, $HC_2H_3O_2$, or H_3PO_4+Aq.

Insol. in alcohol.

Sodium hydrogen *pyro*phosphate, $Na_2H_2P_2O_7$.

Decomp. by H_2O. Sol. in H_2O containing $HC_2H_3O_2$ without decomp. (Bayer, J. pr. **106.** 501.)

Sl. sol. in alcohol. Much more sol. in H_2O than NaH_2PO_4.

$+6H_2O$. (Rammelsberg, B. A. B. **1883.** 21.)

$Na_6H_2(P_2O_7)_2+2H_2O$. (Rammelsberg.)

Sodium *tetra*phosphate, $Na_6P_4O_{13}$.

Slowly sol. in 2 pts. cold H_2O. Easily decomp.

$+18H_2O$. (Uelsmann.)

Sodium hydrogen *tetra*phosphate, $Na_4H_2P_4O_{13}$.

Sol. in H_2O.

Sodium *deka*phosphate, $Na_{12}P_{10}O_{31}$.

Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 333.)

Sodium strontium *trimeta*phosphate, $NaSrP_3O_9+3H_2O$.

Easily sol. in H_2O and acids. (Fleitmann, A. **65.** 315.)

Sodium strontium phosphate, $NaSr(PO_4)+H_2O$.

Scarcely sol. in H_2O; sol. in acids.

$+9H_2O$. (Joly, C. R. **104.** 905.)

Sodium strontium *pyro*phosphate (?).

Sl. sol. in H_2O. Insol. in $Na_4P_2O_7+Aq$. (Baer, Pogg. **75.** 166.)

Easily sol. in $HCl+Aq$, or HNO_3+Aq.

Sol. in NH_4OH+Aq.

Sodium thorium *ortho*phosphate, $NaTh_2(PO_4)_3$.

Insol. in acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

Sodium thorium phosphate, Na_2O, $4ThO_2$, $3P_2O_5$.

Insol. in HNO_3, HCl, or aqua regia. (Troost and Ouvrard, C. R. **105.** 30.)

$5Na_2O$, $2ThO_2$, $3P_2O_5$. Sol. in HNO_3+Aq. (T. and O.)

Na_2O, ThO_2, P_2O_5. (T. and O.)

Sodium thorium *pyro*phosphate, $Na_4P_2O_7$, $ThP_2O_7+2H_2O$.

(Cleve.)

Sodium stannic phosphate, $NaSn_2(PO_4)_3$.

(Ouvrard, C. R. **111.** 177.)

$Na_2Sn(PO_4)_2$. (Wunder, J. pr. (2) **4.** 339.)

$6Na_2O$, $3SnO_2$, $4P_2O_5$. (Ouvrard.)

Sodium titanium phosphate, $NaTi_2(PO_4)_3$.

Insol. in acids. (Rose, J. B. **1867.** 9.)

$6Na_2O$, TiO_2, $4P_2O_5$. (Ouvrard, C. R. **111.** 177.)

Sodium uranyl phosphate, Na_2O, UO_3, P_2O_5.

(Ouvrard, C. R. **110.** 1333.)

$2Na_2O$, UO_3, P_2O_5. (Ouvrard.)

Na_2O, $5UO_3$, $2P_2O_5+3H_2O$. Insol. in H_2O; decomp. by acetic acid. (Werther, A. **68.** 312.)

Sodium uranyl *pyro*phosphate.

Very sol. in H_2O. (Persoz, A. ch. (3) **20.** 322.)

Sodium ytterbium *pyro*phosphate, $NaYbP_2O_7$.

Easily sol. in the strong acids. (Wallroth.)

Sodium yttrium *pyro*phosphate, $NaYP_2O_7$.

Sol. in H_2O. (Stromeyer.)

Insol. in H_2O. Easily sol. in strong acids. (Wallroth.)

Sodium zinc *trimeta*phosphate, Na_2O, $2ZnO$, $3P_2O_5$.

Ppt. Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 304.)

Sodium zinc phosphate, $NaZnPO_4$.

Difficultly sol. in H_2O or acetic acid. Easily sol. in dil. mineral acids. (Scheffer, A. **145.** 53.)

$2Na_2O$, ZnO, P_2O_5. Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1796.)

Sodium zinc *pyro*phosphate, $Na_2ZnP_2O_7$.

Insol. in H_2O; sol. in dil. acids. (Wallroth.)

$3Na_4P_2O_7$, $Zn_2P_2O_7+24H_2O$. Very efflorescent. (Pahl.)

$Na_4P_2O_7$, $Zn_2P_2O_7+2\frac{1}{2}$, 3, $3\frac{1}{2}$, and $8H_2O$. Insol. in H_2O; sol. in $Na_4P_2O_7+Aq$. (Pahl, Sv. V. A. F. **30, 7.** 35.)

$4Na_4P_2O_7$, $5Zn_2P_2O_7+20H_2O$. Insol. in H_2O. (Pahl.)

$Na_4P_2O_7$, $4Zn_2P_2O_7+12H_2O$. Sl. sol. in H_2O. (Pahl.)

Sodium zirconium phosphate, Na_2O, $4ZrO_2$, $3P_2O_5=NaZr_2(PO_4)_3$.

Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. **105.** 30.)

$6Na_2O$, $3ZrO_2$, $4P_2O_5$. Sol. in acids. (T. and O.)

$4Na_2O$, ZrO_2, $2P_2O_5$. Sol. in acids. (T. and O.)

Sodium phosphate fluoride, Na_3PO_4, $NaF+12H_2O$.

100 pts. H_2O dissolve, at 25°, 12 pts. salt and form solution of 1·0329 sp. gr.; at 70°, 57·5 pts. salt and form solution of 1·1091 sp. gr. (Briegleb, A. **97.** 95.)

$2Na_3PO_4$, $NaF+19H_2O$, and $22H_2O$. Sol. in H_2O. (Baumgarten, J. B. **1865.** 219.)

Sodium phosphate vanadate.

See **Phosphovanadate, sodium.**

Strontium *monometa*phosphate, $Sr(PO_3)_2$.

Insol. in H_2O and acids. Not decomp. by alkali carbonates + Aq. (Maddrell, A. **61**. 61.)

Strontium *hexameta*phosphate.

Nearly insol. in H_2O; easily sol. in acids. (Lüdert, Z. anorg. **5**. 15.)

Strontium *ortho*phosphate, $Sr_3(PO_4)_2$.

Insol. in H_2O. Sol. in HCl + Aq. (Erlenmeyer, J. B. **1857**. 145.)

Strontium hydrogen phosphate, $SrHPO_4$.

Insol. in H_2O. Sol. in H_3PO_4, HCl, or HNO_3 + Aq. (Vauquelin.) Easily sol. in cold ammonium nitrate, chloride, or succinate + Aq, but is partly precipitated by a little NH_4OH + Aq. (Brett.)

Sol. in boiling NH_4Cl + Aq. (Fuchs, **1834**.)

Sol. in Na citrate + Aq. (Spiller.)

Partly decomp. by boiling Na_2CO_3, and K_2CO_3 + Aq. (Dulong.)

$SrH_4(PO_4)_2 + 2H_2O$. Decomp. by treating with H_2O, leaving 4·29 % $SrHPO_4$. (Barthe.)

Strontium phosphate, acid, H_2O, $2SrO$, $3P_2O_5 + xH_2O$.

Entirely sol. in H_2O. (Barthe, C. R. **114**. 1267.)

Strontium *pyro*phosphate, $Sr_2P_2O_7 + H_2O$.

Somewhat sol. in H_2O. Easily sol. in HCl or HNO_3 + Aq. Insol. in $HC_2H_3O_2$ or $Na_4P_2O_7$ + Aq. (Schwarzenberg, A. **65**. 144.)

$+ 2\frac{1}{2}H_2O$. (Knorre and Oppelt, B. **21**. 773.)

Strontium hydrogen *pyro*phosphate, $SrH_2P_2O_7$, $2Sr_2P_2O_7 + 6H_2O$.

Ppt. (Knorre and Oppelt, B. **21**. 772.)

$SrH_2P_2O_7$, $3Sr_2P_2O_7 + H_2O$, and $+ 2H_2O$. (Knorre and Oppelt.)

Strontium phosphate chloride, $3Sr_3(PO_4)_2$, $SrCl_2$.

Strontium apatite. Insol. in H_2O. (Deville and Caron.)

Tellurium phosphate (?).

Insol. in H_2O. (Berzelius.)

Thallous *meta*phosphate, $TlPO_3$.

Two modifications:

α. Difficultly sol. in H_2O.

β. Extremely easily sol. in H_2O. (Lamy.)

Thallous *ortho*phosphate, Tl_3PO_4.

1 pt. is sol. in 201·2 pts. H_2O at 15°, and 149 pts. boiling H_2O; sol. in HNO_3 + Aq. (Crookes.) Sl. sol. in $HC_2H_3O_2$ + Aq. Very easily sol. in solutions of NH_4 salts. (Carstanjen.) Insol. in alcohol. (Lamy.)

Thallous hydrogen phosphate, Tl_2HPO_4.

Anhydrous. Much less sol. in H_2O than the hydrous salt, but easily sol. in a solution of the hydrous salt. (Lamy.)

$+ \frac{1}{2}H_2O$. Easily sol. in H_2O. Insol. in alcohol. (Lamy.)

Composition is HTl_2PO_4, $2H_2TlPO_4$. (Rammelsberg, W. Ann. **16**. 694.)

Thallous *di*hydrogen phosphate, TlH_2PO_4.

Very easily sol. in H_2O. Insol. in alcohol. (Rammelsberg, B. **3**. 278.)

Thallous phosphate, Tl_2HPO_4, $2TlH_2PO_4$.

True composition of Tl_2HPO_4 of Lamy. (Rammelsberg.)

Thallous *pyro*phosphate, $Tl_4P_2O_7$.

Sol. in 2·5 pts. H_2O with slight decomposition. (Lamy.)

$+ 2H_2O$. More sol. in H_2O than the above salt, with partial decomp. (Lamy.)

Thallous hydrogen *pyro*phosphate, $H_2Tl_2P_2O_7 + H_2O$.

Very sol. in H_2O. (Lamy.)

Thallic phosphate, basic, $2Tl_2O_3$, $P_2O_5 + 5H_2O$.

Insol. in H_2O.

Thallic phosphate, basic, $Tl_8P_6O_{27} + 13H_2O$.

(Rammelsberg, W. Ann. **16**. 694.)

$Tl_6P_4O_{19} + 12H_2O$. (R.)

Thallic phosphate, $TlPO_4 + 2H_2O$.

Completely insol. in H_2O. Sol. in conc. HNO_3, and dil. HCl + Aq. (Willm.)

Thorium *meta*phosphate, $Th(PO_3)_4$.

Insol. in H_2O. (Troost, C. R. **101**. 210.)

Thorium *meta*phosphate, ThO_2, $2P_2O_5$.

Insol. in acids. (Johnsson, B. **22**. 976.)

Thorium *ortho*phosphate, $Th_3(PO_4)_4 + 4H_2O$.

Insol. in H_2O and phosphoric acid (Berzelius); also acetic acid (Cleve).

Sol. in HCl, and HNO_3 + Aq. (Cleve.)

Thorium hydrogen phosphate, $ThH_2(PO_4)_2 + H_2O$.

Precipitate.

Thorium *pyro*phosphate, $ThP_2O_7 + 2H_2O$.

Precipitate. Insol. in H_2O. Sol. in great excess of pyrophosphoric acid or sodium pyrophosphate + Aq. (Cleve.)

Stannous phosphate, $5SnO$, $4P_2O_5 + 4H_2O$.

Insol. in H_2O. (Lenssen, A. **114**. 113.)

$Sn_3(PO_4)_2$. Insol. in H_2O. Sol. in mineral acids. (Kühn.)

Insol. in NH_4Cl or NH_4NO_3 + Aq. Sol. in KOH + Aq.

Stannic phosphate, $2SnO_2$, $P_2O_5 + 10H_2O$.

Insol. in H_2O or HNO_3 + Aq. (Reynoso, J. pr. **54**. 261.)

Anhydrous. Insol. in acids. (Hautefeuille and Margottet, C. R. **102**. 1017.)

Stannic phosphate, SnP_2O_7.

Insol. in acids. (Hautefeuille and Margottet, C. R. **102**. 1017.)

Stannous phosphate chloride, $3SnO$, P_2O_5, $SnCl_2 + H_2O$.

Not decomp. by hot H_2O. (Lenssen, A. **114**. 113.)

Titanium phosphate, $Ti_2P_2O_9 = 2TiO_2$, P_2O_5.

Insol. in acids. (Hautefeuille and Margottet, C. R. **102**. 1017.)

(Ouvrard, C. R. **111.** 177.)

$+3H_2O$. Ppt. Insol. in H_2O. (Merz.)

TiO_2, P_2O_5. (Knop.) Is $NaTi_2(PO_4)_3$. (Wunder, J. B. **1871.** 324.)

Uranous hydrogen *ortho***phosphate,** $UHPO_4+H_2O$.

Insol. in H_2O. Insol. in dil., sl. sol. in conc. $HCl+Aq$. Decomp. by $KOH+Aq$, not by NH_4OH+Aq. (Rammelsberg, Pogg. **59.** 1.)

Uranic *meta***phosphate,** $U_2(PO_3)_6$.

Insol. in H_2O and acids. (Hautefeuille and Margottet, C. R. **96.** 849.)

Uranous *pyro***phosphate,** $UP_2O_7+3H_2O$ (?).

Precipitate.

Uranyl *meta***phosphate,** $UO_2(PO_3)_2$.

(Rammelsberg, B. A. B. **1872.** 447.)

UO_3, $2P_2O_5$. Insol. in acids. (Johnsson, B. **22.** 976.)

Uranyl *ortho***phosphate,** $UO_2HPO_4+1\frac{1}{2}H_2O$.

Insol. in H_2O.

$+3H_2O$.

$+4H_2O$.

$+4\frac{1}{2}H_2O$. Insol. in H_2O. Sol. in 67,000 pts. $HC_2H_3O_2+Aq$, 50,000 pts. $NH_4C_2H_3O_2+Aq$, and 300,000 pts. of a mixture of the above two solutions. Sol. in K_2CO_3 or Na_2CO_3+Aq. (Kitschin, C. N. **27.** 199.)

Uranyl *di***hydrogen phosphate,** $UO_2H_4(PO_4)_2+3H_2O$.

Decomp. by H_2O. Sol. in H_3PO_4+Aq. (Werther, J. pr. **43.** 322.)

Uranyl *pyro***phosphate,** $(UO_2)_2P_2O_7+5H_2O$.

Efflorescent. Insol. in H_2O. Sol. in HNO_3+Aq, and $Na_4P_2O_7+Aq$. Insol. in Na_2HPO_4+Aq. Insol. in alcohol or ether. (Girard, C. R. **34.** 22.)

$+4H_2O$. (Casteing, Bull. Soc. (2) **34.** 20.)

Uranyl *tetra***phosphate** (?), $UO_2P_4O_{11}$.

(Johnsson, B. **22.** 978.)

*Di***vanadyl phosphate.**

Very deliquescent, and sol. in H_2O. Insol. in alcohol. (Berzelius.)

Vanadium phosphate, $(VO_2)H_2PO_4+4\frac{1}{2}H_2O$.

Sol. in H_2O.

See **Phosphovanadic acid.**

Yttrium *meta***phosphate,** $Y(PO_3)_3$.

Insol. in H_2O or acids. (Cleve.)

Yttrium *ortho***phosphate,** YPO_4.

Anhydrous. Insol. in H_2O or acids after ignition.

Min. *Xenotime.* Insol. in conc. acids. Sl. sol. in much conc. $HCl+Aq$, but easily sol. therein when first heated with a little $HCl+Aq$. (Wartha, A. **139.** 237.)

Yttrium hydrogen *ortho***phosphate,** $Y_2(HPO_4)_3$.

Decomp. by boiling with H_2O into insol. YPO_4 and sol. acid salt.

Yttrium *pyro***phosphate,** $YHP_2O_7+3\frac{1}{2}H_2O$.

Difficultly sol. in acids. Decomp. by H_2SO_4. Sol. in $Na_4P_2O_7+Aq$. (Cleve.)

$2Y_2O_3$, $3P_2O_5$. Insol. in acids. (Johnsson, B. **22.** 976.)

Zinc *meta***phosphate.**

Sol. in H_2O. (Berzelius.)

Zinc *dimeta***phosphate,** ZnP_2O_6.

Sol. only in boiling H_2SO_4. (Fleitmann, Pogg. **78.** 350.)

Not decomp. by boiling Na_2S or $(NH_4)_2S+Aq$.

$+4H_2O$. Insol. in H_2O, but decomp. by boiling therewith. (Fleitmann, Pogg. **78.** 258.)

Difficultly decomp. by boiling acids.

Zinc *ortho***phosphate,** $Zn_3(PO_4)_2+4H_2O$.

Insol. in H_2O. Easily sol. in acids, NH_4OH, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Heintz, A. **143.** 356.)

Sol. in NH_4Cl+Aq. (Fuchs.)

Easily sol. in Zn salts + Aq. (Rose.)

Min. *Hopeite.*

$+6H_2O$. (Reynoso.)

Zinc hydrogen phosphate, $ZnHPO_4+H_2O$.

Insol. in H_2O; sol. in H_3PO_4+Aq. (Graham.)

Zinc *tetra***hydrogen phosphate,** $ZnH_4(PO_4)_2+2H_2O$.

Nearly insol. in H_2O, but decomp. thereby into H_3PO_4 and $10ZnO$, $4P_2O_5+10H_2O$. (Demel, B. **12.** 1171.)

Zinc phosphate, $10ZnO$, $4P_2O_5+10H_2O$.

Insol. in H_2O. (Demel, B. **12.** 1171.)

Zinc *pyro***phosphate,** $Zn_2P_2O_7+\frac{3}{2}H_2O$.

Ppt. Sol. in H_2SO_3+Aq. Sol. in acids, $KOH+Aq$, NH_4OH+Aq. (Schwarzenberg, A. **65.** 151.)

Sol. in $Na_4P_2O_7+Aq$ (Gladstone), and in $ZnSO_4+Aq$. (Rose.)

$+5H_2O$. Insol. in H_2O. (Pahl, J. B. **1873.** 229.)

Zinc hydrogen *pyro***phosphate.**

Sol. in H_2O. (Pahl, Sv. V. A. F. **30, 7.** 45.)

Zinc *meta***phosphate ammonia.**

Ppt. (Bette.)

Zinc *ortho***phosphate ammonia,** $2ZnO$, P_2O_5, $3NH_3+8H_2O$.

(Rother, A. **143.** 356.)

$6ZnO$, $3P_2O_5$, $8NH_3+4H_2O$. (Schweikert, A. **145.** 517.)

Zinc *pyro***phosphate ammonia,** $3Zn_2P_2O_7$, $4NH_3+9H_2O$.

Ppt. Insol. in H_2O. (Bette.)

Zirconium *ortho***phosphate,** $5ZrO_2$, $4P_2O_5+8H_2O$.

Somewhat sol. in acids. (Hermann, J. pr. **97.** 321.)

Insol. in acids. (Paykull, Bull. Soc. (2) **20.** 65.)

$2ZrO_2$, P_2O_5. Not attacked by acids. (Hautefeuille and Margottet, C. R. **102.** 1017.)

Zirconium *pyro***phosphate,** $Zr(PO_3)_2$.

(Knop, A. **159.** 36.)

Phosphor nitryl, PON.

See **Phosphoryl nitride.**

Phosphorosomolybdic acid.

Ammonium phosphorosomolybdate, $2(NH_4)_2O$, $2H_3PO_3$, $12MoO_3+12\frac{1}{2}H_2O$.

Insol. in cold, slightly sol. in hot H_2O. (Gibbs, Am. Ch. J. **5**. 361.)

Phosphorosophosphomolybdic acid.

Ammonium phosphorosophosphomolybdate, $9(NH_4)_2O$, $2H_3PO_3$, $3P_2O_5$, $72MoO_3+38H_2O$.

Nearly insol. in H_2O. (Gibbs.)

Phosphorosophosphotungstic acid.

Potassium phosphorosophosphotungstate, $5K_2O$, $2H_3PO_3$, P_2O_5, $24WO_3+13H_2O$.

Sol. in much boiling H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

Phosphorosotungstic acid.

Ammonium phosphorosotungstate, $6(NH_4)_2O$, $4H_3PO_3$, $22WO_3+25H_2O$.

Sl. sol. in cold H_2O.

Potassium ——, $5K_2O$, $16H_3PO_3$, $32WO_3+46H_2O$.

Sl. sol. in hot H_2O.

Sodium ——, $2Na_2O$, $8H_3PO_3$, $22WO_3+35H_2O$.

Nearly insol. in cold, sl. sol. in hot H_2O. (Gibbs, Am. Ch. J. **7**. 313.)

Phosphorous anhydride, P_2O_3.

See **Phosphorus *tri*oxide.**

Phosphorous acid, H_3PO_3.

Deliquescent. Very sol. in H_2O.

Phosphites.

The neutral alkali phosphites are sol. in H_2O; most of the others are sl. sol. in H_2O, but sol. in H_3PO_3+Aq; all are insol. in alcohol.

Aluminum phosphite.

Precipitate. (Rose, Pogg. **9**. 39.)
Sl. sol. in H_2O.

Ammonium phosphite, $(NH_4)_2HPO_3+H_2O$.

Very deliquescent, and sol. in H_2O. (Rose, Pogg. **9**. 28.)
Sol. in 2 pts. cold, and less hot H_2O. Insol. in alcohol. (Berzelius.)

Ammonium hydrogen phosphite $(NH_4H)HPO_3$.

Very deliquescent, and sol. in H_2O. 1 pt. H_2O dissolves 1·71 pts. salt at 0°; 1·9 pts. at 14·5°, and 2·60 pts. at 31°. (Amat, C. R. **105**. 809.)

Ammonium magnesium phosphite, $(NH_4)_2Mg_3(PHO_3)_4+16H_2O$.

Slightly sol. in H_2O. (Rammelsberg, Pogg. **131**. 367.)

Barium phosphite, $BaHPO_3$.

100 pts. H_2O dissolve 0·25 pt. (Ure.)

Very slightly sol. in H_2O, and decomp. by boiling H_2O. (Dulong.)
Easily sol. in H_2O containing NH_4Cl. (Wackenroder, A. **41**. 315.)
Sol. in H_3PO_3+Aq or $HCl+Aq$. (Railton.)

Barium hydrogen phosphite, $Ba_2H_2(PHO_3)_3+8H_2O$.

Easily sol. in H_2O, but decomp. by boiling therewith. Insol. in alcohol. (Rammelsberg, Pogg. **132**. 496.)

Barium *di*hydrogen phosphite, $BaH_2(PHO_3)_2+\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Rose, Pogg. **9**. 215.)
$+H_2O$. Sol. in H_2O; decomp. by boiling H_2O into a neutral insol., and an acid sol. salt. (Wurtz, A. **58**. 66.)
$+2H_2O$. Easily sol. in H_2O. (Rammelsberg, Pogg. **132**. 496.)
Insol. in alcohol. (Wurtz.)

Bismuth phosphite, $2Bi_2O_3$, $3P_2O_3$.

Insol. in H_2O.

Cadmium phosphite, $CdPHO_3+3H_2O$.

Ppt. (Rose, Pogg. **9**. 41.)

Calcium phosphite, $CaHPO_3+\frac{3}{2}H_2O$.

Sl. sol. in H_2O; the aqueous solution is decomp. by boiling.
$+H_2O$. Sol. in NH_4Cl+Aq. (Wackenroder, A. **41**. 315.)
Insol. in alcohol.

Calcium hydrogen phosphite, $CaH_2(PHO_3)_2+H_2O$.

Sol. in H_2O. Aqueous solution is decomp. by alcohol. (Wurtz, A. ch. (3) **7**. 212.)

Chromic phosphite.

Precipitate. Almost insol. in H_2O. (Rose Pogg. **9**. 40.)

Cobaltous phosphite, $CoPHO_3+2H_2O$.

Ppt. Sl. sol. in H_2O. (Rose.)

Cupric phosphite, $CuPHO_3+2H_2O$.

Ppt. Insol. in H_2O. (Wurtz, A. ch. (3) **16**. 213.)

Didymium phosphite, $Di_2(PHO_3)_3$.

Precipitate. (Frerichs and Smith, A. **191**. 331.)

Glucinum phosphite.

Precipitate. Insol. in H_2O. (Rose, Pogg. **9**. 39.)

Ferrous phosphite, $FeHPO_3+xH_2O$.

Ppt. Nearly insol. in H_2O. (Rose, Pogg. **9**. 35.)

Ferric phosphite, $Fe_2(HPO_3)_3+9H_2O$.

Ppt. Sol. in iron alum + Aq. (Rose.)

Lanthanum phosphite, $La_2(HPO_3)_3$.

Precipitate. (Smith.)

Lead phosphite, basic, $4PbO$, $P_2O_3+2H_2O$.

Ppt. (Rose, Pogg. **9**. 222.)
$3PbO$, $P_2O_3+H_2O$. Insol. in H_2O. Sol. in warm dil. H_3PO_3+Aq, from which it is pptd. by NH_4OH+Aq. (Wurtz, A. ch. (3) **16**. 214.)

Lead phosphite, $PbHPO_3$.

Insol. in H_2O. Very sl. sol. in a solution of phosphorous acid; easily sol. in cold HNO_3+Aq. (Wurtz.)

Lead hydrogen phosphite, $PbH_4(PO_3)_2$.

Decomp. by H_2O. (Amat, C. R. **110**. 901.)

Lead *pyro*phosphite, $PbH_2P_2O_5$.

Gradually decomp. by H_2O into H_3PO_3 and $PbHPO_3$. (Amat, C. R. **110**. 903.)

Lithium hydrogen phosphite, LiH_2PO_3.

Very sol. in H_2O. (Amat, A. ch. (6) **24**. 309.)

Lithium *pyro*phosphite, $Li_2H_2P_2O_5$.

Very sol. in H_2O. (Amat.)

Magnesium phosphite, $MgHPO_3+3H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **9**. 28.)

Sol. in 400 pts. H_2O. (Berzelius.)

$+4H_2O$.

Manganous phosphite, $MnHPO_3+\frac{1}{2}H_2O$.

Difficultly sol. in H_2O, easily in $MnCl_2$ or $MnSO_4$+Aq. (Rose, Pogg. **9**. 33.)

Nickel phosphite, $NiHPO_3+3\frac{1}{2}H_2O$.

Ppt. Sl. sol. in H_2O.

Potassium phosphite, K_2HPO_3.

Very deliquescent. Very sol. in H_2O. Insol. in alcohol. (Dulong.)

Potassium hydrogen phosphite, $(KH)HPO_3$.

1 pt. H_2O dissolves about 1·72 pts. salt at 20°. (Amat, C. R. **106**. 1351.)

K_2HPO_3, $2H_3PO_3$. Very sol. in H_2O. (Wurtz, A. **58**. 63.)

Sol. in 3 pts. cold, and in less hot H_2O. (Fourcroy and Vauquelin.)

Potassium *pyro*phosphite, $K_2H_2P_2O_5$.

Very sol. in H_2O. (Amat, A. ch. (6) **24**. 351.)

Sodium phosphite, basic, Na_2HPO_3, NaOH (?).

Not obtained in pure state (Zimmerman, B. **7**. 290); $=Na_3PO_3$ (Wislicenus).

Does not exist. (Amat.)

Sodium phosphite, $Na_2HPO_3+5H_2O$.

Deliquescent, and very sol. in H_2O. Insol. in alcohol.

Correct formula for Na_3PO_3 of Rose and Dulong.

Sodium hydrogen phosphite, $(NaH)HPO_3+2\frac{1}{2}H_2O$.

0·56 pt. salt dissolves in 1 pt. H_2O at 0°; 0·66 pt. at 10°; 1·93 pts. at 42°. (Amat, C. R. **106**. 1351.)

$Na_2H_4(HPO_3)_3+H_2O$. Deliquescent in moist air. Sol. in 2 pts. cold, and about the same amt. hot H_2O. Sl. sol. in spirit. (Fourcroy and Vauquelin.)

Sodium *pyro*phosphite, $Na_2H_2P_2O_5$.

Very sol. in H_2O with gradual decomp. into Na_2HPO_3. (Amat.)

Strontium phosphite, $SrHPO_3+1\frac{1}{2}H_2O$.

Difficultly sol. in H_2O. Aqueous solution decomp. on heating into a sol. acid salt and an insol. basic salt.

Strontium hydrogen phosphite, $SrH_4(PO_3)_2$.

Very sol. in H_2O. (Amat, A. ch. (6) **24**. 312.)

Thallous hydrogen phosphite, TlH_2PO_3.

Very sol. in H_2O. (Amat, A. ch. (6) **24**. 310.)

Thallous *pyro*phosphite, $Tl_2H_2P_2O_5$.

Deliquescent. Very sol. in H_2O. (Amat.)

Stannous phosphite, $SnHPO_3$.

Ppt. Sol. in HCl+Aq. (Rose, Pogg. **9**. 45.)

Stannic phosphite, $2SnO_2$, P_2O_3.

Ppt. (Rose, Pogg. **9**. 47.)

Titanium phosphite (?).

Precipitate. (Rose, Pogg. **9**. 47.)

Uranyl phosphite, $(UO_2)_3H_2(HPO_3)_4+12H_2O$.

Precipitate. (Rammelsberg, Pogg. **132**. 500.)

Zinc phosphite, $ZnHPO_3$.

Sol. in H_2O. (Rammelsberg, Pogg. **132**. 481.)

$+2\frac{1}{2}H_2O$. More easily sol. in cold than warm H_2O. (Rammelsberg.)

Zinc phosphite, acid, $Zn_2H_3P_3O_8$.

Sol. in H_2O.

$+2H_2O$. Sol. in H_2O. (Rammelsberg, Pogg. **132**. 498.)

$Zn_3H_5P_5O_{13}$. Sol. in H_2O.

$+3H_2O$. Sol. in H_2O. (Rammelsberg.)

$Zn_2H_9P_5O_{14}$. Sol. in H_2O.

$+H_2O$. Sol. in H_2O. (Rammelsberg.)

Phosphorus, P_4.

(a) *Ordinary phosphorus.* Insol. in H_2O, but slowly decomp. thereby (G. K.); very sl. sol. in H_2O (Berzelius and others).

Easily sol. in SCl_2, especially if hot. (Wöhler.)

Sol. in sulphur phosphides.

Largely sol. in PCl_3.

Easily sol. in PCl_5.

Sol. with decomp. in hot conc. HNO_3+Aq.

Decomp. by boiling caustic alkalies+Aq.

Sol. in 320 pts. cold alcohol of 0·799 sp. gr., and in 240 pts. of the same when warm. Pptd. from alcoholic solution by H_2O. (Buchner.)

One grain P dissolves in 1 ounce abs. alcohol. (Schacht.)

Sol. in 20 pts. absolute ether at 20° and 240 pts. ordinary ether at 20°. (Bucholz.)

Sol. in 80 pts. absolute ether at 15·5°, and 240 pts. ordinary ether at 15·5°. (Brugnatelli, A. ch. **24**. 73.)

Sol. in 0·05 pt. CS_2 (Böttger); 0·125 pt. (Trommsdorf).

Alcohol ppts. P from CS_2 solution.

1 pt. CS_2 dissolves 17-18 pts. P. (Vogel, J. B. **1868**. 149.)

Sl. sol. in "liquid paraffine." (Crismer, B. **17**. 649.)

Very sol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

$HC_2H_3O_2$ dissolves about 1 % P.

Strong vinegar dissolves P. (Beudet.)

Sol. in considerable amount in stearic acid. (Vulpius, Arch. Pharm. (3) **13.** 38.)

Sol. in ethyl chloride, benzoyl chloride, stannic chloride, and in liquid cyanogen.

Sl. sol. in ethyl nitrite, and wood-spirit.

Sl. sol. in acetone, with gradual decomposition.

Insol. in nicotine, and coniine.

Sl. sol. in cold, more sol. in hot benzene. (Mansfield.)

Sol. in 14 pts. hot, and less in cold petroleum from Amiano. (Saussure.)

Sl. sol. in warm essential oils, as oil of turpentine, and in the fatty oils.

Sol. in hot oil of copaiba, separating out on cooling.

Sol. in hot oil of caraway, and mandarin oil. (Luca.)

Sl. sol. in cold, more sol. in hot caoutchin, depositing on cooling.

Readily sol. in warm, less in cold styrene.

Sol. in aniline, and chinoline. (Hofmann.)

Sl. sol. in cold creosote.

Somewhat sol. in fusel oil.

Easily sol. in valerianic acid, and amyl valerate.

Sol. in hexylic alcohol, ethylene chloride, allyl sulphocyanide, mercury methyl, chloroform, bromoform, warm chloral, acetic ether, aldehyde, hot cacodyl sulphide, and in cacodyl oxide.

(b) *Amorphous phosphorus.* Insol. in H_2O. Insol. in $NH_4OH + Aq$. (Flückiger.)

Sol. in boiling $KOH + Aq$.

Insol. in CS_2, alcohol, ether, naphtha, ligroine, PCl_3, etc.

Sl. sol. in boiling oil of turpentine and other high-boiling liquids, with conversion into ordinary phosphorus.

Insol. in $KOH + Aq$.

Conc. H_2SO_4 does not act upon it in the cold, but dissolves easily when hot.

Insol. in dil., easily sol. in conc. $HNO_3 + Aq$ with decomposition.

Much more sol. in $HNO_3 + Aq$ than ordinary P. (Personne, C. R. **45.** 115.)

Insol. in methylene iodide. (Retgers.)

(c) *Crystalline.* Insol. in, and not attacked by, dil. $HNO_3 + Aq$.

Sol. in CS_2.

Phosphorus *tri*bromide, PBr_3.

Decomposed by H_2O, slowly at 8°, but very rapidly at 25°. (Löwig, Pogg. **14.** 485.)

Sol. in CS_2.

Dissolves phosphorus.

Phosphorus *penta*bromide, PBr_5.

Fumes on air, and is violently decomp. by H_2O.

Phosphorus *tri*bromide ammonia, $3PBr_3, 5NH_3$.

Slowly but completely sol. with decomp. in H_2O. (Storer's Dict.)

Phosphorus *penta*bromide ammonia, PBr_5, $9NH_3$.

(Besson, C. R. **111.** 972.)

Phosphorus thiophosphoryl bromide, PBr_3, $PSBr_3$.

Decomp. by H_2O into $PSBr_3$. (Michaelis.)

Phosphorus *mono*bromo*tetra*chloride, $PBrCl_4$.

Decomp. by H_2O. (Prinvault, C. R. **74.** 868.)

Phosphorus *di*bromo*tri*chloride, PCl_3Br_2.

Very unstable. (Michaelis, B. **5.** 9.)

Phosphorus *tetra*bromo*tri*chloride, PCl_3Br_4.

Decomp. with H_2O. (Geuther.)

Phosphorus *hepta*bromo*di*chloride, PCl_2Br_7.

Very unstable. (Prinvault, C. R. **74.** 868.)

Phosphorus *octo*bromo*tri*chloride, PCl_3Br_8.

Very easily decomp. (Michaelis, B. **5.** 9.)

Phosphorus bromofluoride, PF_3Br_2.

Decomp. violently with H_2O. (Moissan, Bull. Soc. (2) **43.** 2.)

Phosphorus bromonitride.

See **Nitrogen bromophosphide.**

Phosphorus *tri*chloride, PCl_3.

Gradually decomp. by H_2O.

Miscible with CS_2, C_6H_6, $CHCl_3$, and ether.

Decomp. with alcohol.

Phosphorus *penta*chloride, PCl_5.

Very deliquescent, and sol. in H_2O with violent decomp. and evolution of heat. Sol. in liquid HCl. Somewhat sol. without decomp. in CS_2. (Schiff, A. **102.** 118.)

Sol. without decomp. in benzoyl chloride. (Gerhardt.)

Sol. in oil of turpentine with evolution of heat.

***Mono*phosphorus platinous chloride**, PCl_3, $PtCl_2$.

Deliquescent. Sol. in H_2O with formation of chloroplatinophosphoric acid. Similarly decomp. by alcohol. Abundantly sol. in hot benzene, toluene, chloroform, or carbon tetrachloride, and crystallises on cooling. (Schützenberger, Bull. Soc. (2) **17.** 482.)

***Di*phosphorus platinous chloride**, $2PCl_3, PtCl_2$.

Decomp. by H_2O with formation of chloroplatino*di*phosphoric acid. Similarly decomp. by alcohol. Sol. without decomp. in PCl_3, CCl_4, $CHCl_3$, C_6H_6, or C_7H_8. (Schützenberger.)

Sol. in propyl alcohol with formation of the propyl ether of platinochlorophosphorous acid and HCl. (Pomey, C. R. **104.** 364.)

Phosphorus *di*platinous chloride, $PCl_3, 2PtCl_2$.

Sol. in alcohol, with formation of ether $(PtCl_2)_2P(OC_2H_5)_3$. (Cochin, C. R. **86.** 1402.)

Phosphorus platinic chloride, PCl_3, $PtCl_4$.

(Schützenberger.)

Phosphorus *penta*chloride platinic chloride, PCl_5, $PtCl_4$ or $(PCl_4)_2PtCl_6$.

Decomp. at once by H_2O. (Baudrimont, A. ch. (4) **2.** 47.)

Phosphorus *penta*chloride selenium *tetra*chloride, $2PCl_5, SeCl_4$.

Sol. in H_2O with decomp. (Baudrimont, A. ch. (4) **2.** 5.)

Phosphorus *penta*chloride stannic chloride, $PCl_5, SnCl_4$.

Very deliquescent. Sol. in much H_2O with evolution of heat, forming $SnCl_4$, HCl, and H_3PO_4, and soon separates out stannic phosphate. (Casselmann, A. **83.** 257.)

Phosphorus *tri*chloride titanium chloride, $PCl_3, TiCl_4$.

(Bertrand, Bull. Soc. (2) **33.** 565.)

Phosphorus *penta*chloride titanium chloride, $PCl_5, TiCl_4$.

Deliquescent. Decomp. by H_2O and alcohol. Sol. in ether. Sl. sol. in PCl_3. (Tüttschew, A. **141.** 111.)

Completely sol. in dil. acids. (Weber.)

Phosphorus *penta*chloride tungsten *tri*oxide, $2PCl_5, WO_3$ (?).

(Persoz and Bloch, C. R. **28.** 389.)

Phosphorus uranium *penta*chloride, PCl_5, UCl_5.

Decomp. with H_2O.

Phosphorus *penta*chloride zirconium chloride, $PCl_5, ZrCl_4$.

Decomp. by H_2O with pptn. of Zr phosphate. (Paykull.)

Phosphorus *tri*chloride ammonia, $PCl_3, 5NH_3$.

Insol. as such in H_2O, but slowly decomp. by boiling H_2O. More easily sol. with decomp. in acids. Sol. with decomp. by boiling with KOH or NaOH + Aq. (Berzelius.)

Phosphorus *penta*chloride ammonia, $PCl_5, 5NH_3$.

Properties as $PCl_3, 5NH_3$. (Berzelius.)

$PCl_5, 8NH_3$. Sl. decomp. on air. (Besson, C. R. **111.** 972.)

Phosphorus chlorobromide.

See **Phosphorus bromochloride.**

Phosphorus chlorofluoride, PCl_2F_3.

Absorbed by H_2O with decomp. Absorbed by alcohol or ether. (Poulenc, A. ch. (6) **24.** 555.)

Phosphorus chloroiodide, PCl_3I_2.

Decomp. by moist air or H_2O. Sol in CS_2. (Most, B. **13.** 2029.)

Phosphorus chloronitride.

See **Nitrogen chlorophosphide.**

Phosphorus *tri*fluoride, PF_3.

Decomp. slowly by H_2O. (Moissan, Bull. Soc. (2) **43.** 2.)

Rapidly absorbed by KOH or NaOH + Aq, slowly by BaO_2H_2, and K_2CO_3 + Aq. Absorbed by absolute alcohol with decomp. (Moissan, C. R. **99.** 655.)

Phosphorus *penta*fluoride, PF_5.

Fumes on air. (Thorpe, A. **182.** 20.)

Phosphorus *penta*fluoride ammonia, $2PF_5, 5NH_3$.

(Moissan, C. R. **101.** 1490.)

Phosphorus *penta*fluoride nitrogen *per*oxide.

Decomp. by H_2O. (Tassel, C. R. **110.** 1264.)

Phosphorus fluobromide.

See **Phosphorus bromofluoride.**

Phosphorus fluochloride.

See **Phosphorus chlorofluoride.**

Phosphorus *di*iodide, P_2I_4.

Decomp. by H_2O. Sol. in CS_2. (Corenwinder, A. ch. (3) **30.** 242.)

Phosphorus *tri*iodide, PI_3.

Very deliquescent. Decomp. in moist air and by H_2O. (Corenwinder, A. ch. (3) **30.** 242.)

Very sol. in CS_2.

Phosphorus *penta*iodide, PI_5 (?).

(Hampton, C. N. **42.** 180.)

Phosphorus *sub*oxide, P_4O.

Unchanged in dry, gradually oxidised in moist air. Insol. in H_2O, alcohol, ether, and oils; not acted on by HCl + Aq; oxidised by HNO_3 or H_2SO_4. (Marchand, J. pr. **13.** 442.)

Sl. sol. in H_2O. (le Verrier, A. **27.** 167.)

Forms hydrate $P_4O, 2H_2O$, which gives up its H_2O when dried.

Two modifications: (*a*) decomp. slowly by H_2O or alkalies, (*b*) not decomp. by H_2O or alkalies. (Reinitzer and Goldschmidt, B. **13.** 847.)

Is oxyphosphuretted hydrogen (?), $P_4H(OH)$. (Franke, J. pr. (2) **35.** 341.)

—— H_3P_5O.

Insol. in all solvents. Decomp. by H_2O. Not attacked by non-oxidising acids. Decomp. by dil. alkalies. (Gautier, C. R. **76.** 173.)

—— P_4HO.

Insol. in nearly all substances. Not attacked by dilute acids; oxidised by ordinary HNO_3, and conc. H_2SO_4 at 200° Attacked by very dil. alkaline solutions. Perhaps identical with phosphorus *sub*oxide P_4O. (Gautier, C. R. **76.** 49.)

Phosphorus *tri*oxide, P_4O_6 (formerly P_2O_3).

Deliquescent, but very slowly dissolved by cold H_2O to form H_3PO_3. Violently decomp. by hot H_2O or alcohol.

Sol. without decomp. in ether, carbon disulphide, benzene, or chloroform. (Thorpe and Tutton, Chem. Soc. **57.** 545.)

Phosphorus *tetr*oxide, P_2O_4.

Very deliquescent. Sol. with evolution of heat in H_2O. (Thorpe and Fulton, Chem. Soc. **49.** 833.)

Phosphorus *pent*oxide, P_2O_5.

Very deliquescent. Sol. in H_2O with great evolution of heat, forming H_3PO_4.

Phosphorus sulphur oxide, P_2O_5, $3SO_3 = (PO)_2(SO_4)_3$ (phosphoryl sulphate) (?).

Decomp. by H_2O. Sol. in cold, more sol. in warm SO_3. (Weber, B. **20**. 86.)

Phosphorus oxy- compounds.

See under **Phosphoryl compounds.**

Phosphorus oxysulphide.

See **Phosphorus sulphoxide.**

Phosphorus ***semi*****selenide**, P_4Se.

Decomp. with H_2O. Insol. in cold, decomp. by boiling KOH + Aq. Insol. in, but apparently decomp. by alcohol and ether. Easily sol. in CS_2. (Hahn, J. pr. **93**. 430.)

Phosphorus ***mono*****selenide**, P_2Se.

Stable in dry, decomp. in moist air and by H_2O. Insol. in alcohol and ether. Decomp. by boiling KOH + Aq. CS_2 dissolves out P. (Hahn, J. pr. **93**. 430.)

Sl. sol. in CS_2. (Gore, Phil. Mag. (4) **30**. 414.)

Phosphorus ***tri*****selenide**, P_2Se_3.

Decomp. by boiling H_2O and slowly in moist air. Easily sol. in cold KOH + Aq, less easily in M_2CO_3 + Aq. Insol. in alcohol, ether, and CS_2. (Hahn, J. pr. **93**. 430.)

Phosphorus ***penta*****selenide**, P_2Se_5.

Slowly decomp. in moist air or by H_2O, easily by KOH + Aq or alcohol. Insol. in CS_2. Sol. in CCl_4. (Hahn, J. pr. **93**. 430.)

Phosphorus selenides *with* M_2Se.

See **M phosphoselenide,** *under* M.

Phosphorus ***semi*****sulphide**, P_4S (?).

1. *Liquid.* Not decomp. by, and insol. in boiled H_2O. Insol. in alcohol and ether. Sl. sol. in fats and volatile oils; decomp. by alkalies. Dissolves P on warming, with separation on cooling. Sol. in CS_2.

2. *Red modification.* Not attacked at first by HNO_3 + Aq (sp. gr. 1·22), but after a time is attacked with the greatest violence. Weak acids attack only when hot. (Berzelius, A. **46**. 129.)

Existence is doubtful. (Schulze, B. **13**. 1862; Isambert, C. R. **96**. 1628.)

Phosphorus ***mono*****sulphide**, P_2S (?).

1. *Ordinary.* Same properties as phosphorus *semi*sulphide 1.

2. *Red modification.* Unchanged by air, H_2O, or alcohol. Decomp. by conc. KOH + Aq, not by dilute. Sl. sol. in NH_4OH + Aq. (Berzelius, A. **46**. 129.)

Existence is doubtful. (Schulze; Isambert.)

Does not exist. (Helff, Z. phys. Ch. **12**. 206.)

Phosphorus ***sesqui*****sulphide**, P_4S_3.

Not attacked by cold, slowly by hot H_2O. Cold KOH + Aq dissolves with decomp. Oxidised by HNO_3 and aqua regia. Sol. in alcohol and ether with decomp. Sol. in CS_2 (100 pts. CS_2 dissolve 60 pts. P_4S_3), PCl_3, and $PSCl_3$, and in K_2S or Na_2S + Aq. (Lemoine, Bull. Soc. (2) **1**. 407.)

Very sol. in CS_2. (Rebs, A. **246**. 367.)

Phosphorus ***tri*****sulphide**, P_2S_3.

Decomp. by water. (Kekulé, A. **90**. 310.)

Sol. in M_2CO_3 + Aq with separation of S. Easily sol. in KOH, NaOH, NH_4OH + Aq. (Berzelius, A. **46**. 129.)

Sol. in alcohol and ether. (Lemoine.)

Correct formula is P_4S_6. (Isambert, C. R. **102**. 1386.)

Extremely sl. sol. in CS_2. (Rebs, A. **246**. 368.)

Existence doubtful. (Helff, Z. phys. Ch. **12**. 210.)

Phosphorus sulphide, P_4S_7.

Sl. sol. in CS_2. (Mai, A. **265**. 192.)

Phosphorus ***di*****sulphide**, P_3S_6 (formerly P_2S_4).

Almost insol. in CS_2. (Helff.)

Phosphorus ***penta*****sulphide**, P_2S_5.

Very deliquescent. Decomp. by H_2O. Very sol. in KOH, NaOH, NH_4OH + Aq. Sol. in M_2CO_3 + Aq with separation of S at low temp. Decomposes alcohol, acetic acid, etc. (Kekulé, A. **106**. 331.)

Sol. in CS_2. (Isambert, C. R. **102**. 1386.)

Not very sol. in CS_2. (Rebs, A. **246**. 367.)

Phosphorus ***per*****sulphide**, P_2S_{12} (?).

Decomp. by H_2O, alkalies, etc. Consists of S, and mechanically united P. (Ramme, B. **12**. 941.)

Phosphorus sulphides *with* M_2S.

See **M Phosphosulphide,** *under* M.

Phosphorus zinc sulphide, ZnP_2S_2.

Sol. in HCl + Aq with separation of P_2S (?). (Berzelius, A. **46**. 150.)

Phosphorus ***tri*****sulphide ammonia**, P_2S_3, $2NH_3$.

Decomp. by H_2O. (Bineau.)

Phosphorus sulphobromide.

See **Thiophosphoryl bromide.**

Phosphorus sulphochloride.

See **Thiophosphoryl chloride.**

Phosphorus sulphoiodide, P_2S_3I.

Sl. attacked by cold, rapidly by hot H_2O; violently decomp. by fuming HNO_3. Easily sol. in CS_2. Sl. sol. in C_6H_6 or $CHCl_3$, and still less in ether or absolute alcohol. (Ouvrard, C. R. **115**. 1301.)

Phosphorus sulphoxide, $P_4O_6S_4$.

Deliquescent. Easily sol. in H_2O with decomp. Sol. in 2 pts. CS_2 without decomp. Sol. in benzene with decomp. (Thorpe and Tutton, Chem. Soc. **59**. 1019.)

Phosphoryl ***tri*****amide**, $PO(NH_2)_3$.

Insol. in boiling H_2O, KOH + Aq, or dil. acids. Decomp. by long boiling with HCl or HNO_3 + Aq. More easily decomp. with aqua regia. Easily sol. in warm H_2SO_4 or nitrosulphuric acid. (Schiff, A. **101**. 300.)

Does not exist. (Gladstone; Mente, A. **248.** 238.)

Phosphoryl bromide, $POBr_3$.

Not miscible with H_2O, but gradually decomp. in contact with it. Sol. in H_2SO_4, ether, oil of turpentine (Gladstone, Phil. Mag. (3) **35.** 345); in $CHCl_3$, CS_2 (Baudrimont, Bull. Soc. **1861.** 118).

Phosphoryl bromide sulphide.

See **Thiophosphoryl bromide.**

Phosphoryl bromochloride, $POCl_2Br$.

Decomp. by H_2O. (Menschutkin, A. **139.** 343.)

Phosphoryl *di***bromochloride,** $POClBr_2$.

Decomp. by H_2O. (Geuther, Jena. Zeit. **10.** 130.)

Phosphoryl chloride, $POCl_3$.

Decomp. by H_2O. Not acted on by liquid CO_2, P, PH_3, CS_2, I, Br, Cl, etc.

Phosphoryl boron chloride, $POCl_3$, BCl_3.

See **Boron phosphoryl chloride.**

Phosphoryl stannous chloride, $POCl_3$, $SnCl_2$.

Deliquescent. Decomp. by H_2O. (Casselmann, A. **91.** 242.)

Phosphoryl stannic chloride, $POCl_3$, $SnCl_4$.

Deliquescent. Decomp. by H_2O. (Casselmann.)

Phosphoryl titanium chloride, $POCl_3$, $TiCl_4$.

Deliquescent, and decomp. by H_2O. (Weber, Pogg. **132.** 453.)

*Pyro***phosphoryl chloride,** $P_2O_3Cl_4$.

Decomp. violently with H_2O. (Geuther and Michaelis, B. **4.** 766.)

*Meta***phosphoryl chloride,** PO_2Cl.

Decomp. by H_2O. (Gustavson.)
Does not exist. (Michaelis.)

Phosphoryl fluoride, POF_3.

Absorbed and decomp. at once by H_2O or alcohol. (Moissan, C. R. **102.** 1245.)

Phosphoryl imidoamide, $PN_2H_3O = PO(NH)NH_2$.

Insol. in H_2O; gradually decomp. by boiling with H_2O, more rapidly in presence of KOH. Insol. in boiling conc. HCl+Aq. Insol. in cold, decomp. by hot H_2SO_4. Moderately dil. H_2SO_4+Aq dissolves without evolution of gas. Insol. in boiling nitric or nitrosulphuric acid. (Gerhardt, A. ch. (3) **20.** 255.)

Insol. in alcohol, oil of turpentine, etc.

Phosphoryl iodide, $P_3I_6O_8$ (?).

Sol. in H_2O, alcohol, and ether. (Burton, Am. Ch. J. **3.** 280.)

PO_2I_2. (Burton.)

Phosphoryl nitride, PON.

Insol. in H_2O, acids, or alkalies. (Gladstone, Chem. Soc. **2.** 121.)

Phosphoryl thio- compounds.

See **Thiophosphoryl compounds.**

Phosphoselenide, M.

See under **M.**

Phosphosilicic acid.

See **Silicophosphoric acid.**

Phosphosilicovanadic acid, $3SiO_2$, $2V_2O_5$, $2P_2O_5+6H_2O$.

Sol. in H_2O. (Berzelius.)

Phosphosulphide, M.

See under **M.**

Phosphosulphuric anhydride, P_2O_5, $3SO_3$.

Very easily decomp. (Weber, B. **19.** 3190.)

Phosphotungstic acid, P_2O_5, $12WO_3 + 42H_2O$.

Not efflorescent. Sol. in H_2O, alcohol, and ether. (Péchard, C. R. **110.** 754.)

P_2O_5, $16WO_3+69H_2O$. Very efflorescent. Sol. in H_2O, alcohol, and ether. (Péchard, C. R. **109.** 301.)

$+xH_2O=H_5PW_8O_{29} + xH_2O$ (α-phospholuteotungstic acid). Known only in aqueous solution. (Kehrmann, B. **20.** 1808.)

$+48H_2O=H_3PW_8O_{28}+16H_2O$ (α-anhydrophospholuteotungstic acid). Sol. in its crystal H_2O by warmth of the hand; sol. in less than $\frac{1}{8}$ pt. H_2O. (Kehrmann.)

Correct composition is represented by $H_3PW_9O_{31}+9H_2O$. (Kehrmann, Z. anorg. **1.** 422.)

P_2O_5, $20WO_3+8H_2O$. Very efflorescent. (Gibbs, B. **10.** 1386.)

$+19H_2O=H_{11}PW_{10}O_{38}+8H_2O$. Sol. in H_2O. (Scheibler, B. **5.** 801.)

+50, and $62H_2O$. Very efflorescent. (Péchard, C. R. **109.** 301.)

$3H_2O$, P_2O_5, $21WO_3+30H_2O$. Efflorescent. Sol. in H_2O in nearly every proportion.

P_2O_5, $22WO_3+28H_2O=H_5PW_{11}O_{43}+18H_2O$. Efflorescent. (Scheibler, B. **5.** 801.)

Composition is $6H_2O$, $22WO_3$, $P_2O_5+45H_2O$. (Gibbs.)

P_2O_5, $24WO_3+40H_2O=6H_2O$, P_2O_5, $24WO_3+34H_2O$. Very efflorescent. Sol. in H_2O. (Gibbs.)

$+61H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 116.)

$+53H_2O=6H_2O$, P_2O_5, $24WO_3+47H_2O$. Sol. in H_2O. (Gibbs.)

Sol. in ether. If an equal vol. of ether is placed above a layer of conc. aqueous solution of acid, oily drops form between the two layers, which sink to bottom, forming a third layer. The sp. gr. of the latter is 1·525. The crystallised acid dissolved in smallest amt. ether forms an oil of sp. gr. = 2·083. Ethereal solution is miscible with alcohol, and also with a large quantity of H_2O. (Drechsel, B. **20.** 1452.)

Ammonium phosphotungstate, $2(NH_4)_2O$, P_2O_5, $12WO_3+5H_2O$.

Insol. in cold H_2O. (Péchard, C. R. **110.** 754.)

$6(NH_4)_2O$, P_2O_5, $16WO_3+10H_2O$. Easily sol. in hot H_2O. (Péchard.)

$5(NH_4)_2O, P_2O_5, 16WO_3+xH_2O=(NH_4)_5PW_8O_{29}+xH_2O$ (Ammonium α-phospholuteotungstate). Sl. sol. in H_2O. (Kehrmann.)

$3(NH_4)_2O, P_2O_5, 16WO_3+16H_2O=(NH_4)_3PW_8O_{28}+8H_2O$ (Ammonium α-anhydrophospholuteotungstate). Efflorescent. Easily sol. in H_2O. (Kehrmann.)

$3(NH_4)_2O, P_2O_5, 21WO_3+xH_2O$. Rather sl. sol. in cold, easily in hot H_2O and alcohol. Insol. in sat. NH_4Cl+Aq. (Kehrmann and Freinkel, B. **25**. 1972.)

$3(NH_4)_2O, 3H_2O, P_2O_5, 22WO_3+18H_2O$. Sl. sol. in cold H_2O. (Gibbs.)

$3(NH_4)_2O, 3H_2O, P_2O_5, 24WO_3+26H_2O$. Very sl. sol. even in hot H_2O. (Gibbs, Proc. Am. Acad. **16**. 122.)

Ammonium barium *α-anhydro***phospho***luteo***tungstate**, $NH_4BaPW_8O_{28}+xH_2O=(NH_4)_2O, 2BaO, P_2O_5, 16WO_3+xH_2O$.

Sol. in H_2O. (Kehrmann.)

Barium phosphotungstate, $2BaO, P_2O_5, 12WO_3+15H_2O$.

Very efflorescent. Sol. in H_2O; insol. in alcohol. (Péchard, C. R. **110**. 754.)

$3BaO, P_2O_5, 16WO_3+xH_2O=Ba_3(PW_8O_{28})_2+xH_2O$ (Barium α-anhydroluteotungstate). Not efflorescent. Quite difficultly sol. in H_2O. (Kehrmann.)

$2BaO, P_2O_5, 16WO_3+10H_2O$. Efflorescent. (Péchard, A. ch. (6) **22**. 240.)

$2BaO, 6H_2O, P_2O_5, 20WO_3+24H_2O$. Sol. in H_2O. (Gibbs, B. **10**. 1386.)

$6BaO, 2H_2O, P_2O_5, 20WO_3+46H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **16**. 126.)

$7BaO, P_2O_5, 22WO_3+59H_2O$. Sol. in H_2O. (Sprenger, J. pr. (2) **22**. 418.)

$+53H_2O$. (Kehrmann, B. **24**. 2335.)

$4BaO, 2H_2O, P_2O_5, 22WO_3+39H_2O$. Sol. in H_2O without decomp. (Gibbs.)

$BaO, P_2O_5, 24WO_3+59H_2O$. Sol. in H_2O. (Sprenger.)

$2BaO, P_2O_5, 24WO_3+59H_2O$. Sol. in H_2O. (Sprenger.)

$3BaO, P_2O_5, 24WO_3+46H_2O=3BaO, 3H_2O, P_2O_5, 24WO_3+43H_2O$. Easily sol. in hot H_2O. (Gibbs.)

$+58H_2O$. Sol. in H_2O. (Sprenger.)

Efflorescent. Sl. sol. in dil. $BaCl_2$+Aq. (Kehrmann, Z. anorg. **1**. 423.)

Barium potassium phosphotungstate, $5BaO, 2K_2O, P_2O_5, 22WO_3+48H_2O$.

Sol. in H_2O. (Kehrmann and Freinkel, B. **25**. 1968.)

Barium silver phosphotungstate, $4BaO, 3Ag_2O, P_2O_5, 22WO_3+34H_2O$.

Very sl. sol. in H_2O. (Kehrmann and Freinkel, B. **25**. 1966.)

Barium sodium phosphotungstate, $2BaO, Na_2O, P_2O_5, 24WO_3+46H_2O$.

Sol. in H_2O, forming cloudy liquid, which clears up. Solution in HCl is not cloudy. (Brandhorst and Kraut, A. **249**. 380.)

Calcium phosphotungstate, $CaO, 5H_2O, 16WO_3, P_2O_5+3H_2O$.

Readily sol. in H_2O. (Gibbs, Proc. Am. Acad. **16**. 130.)

$2CaO, P_2O_5, 12WO_3+19H_2O$. Efflorescent. Insol. in alcohol. (Péchard, C. R. **110**. 754.)

$2CaO, P_2O_5, 20WO_3+22H_2O$. Efflorescent. (Péchard, A. ch. (6) **22**. 233.)

Cadmium phosphotungstate, $2CdO, P_2O_5, 12WO_3+13H_2O$.

Sl. efflorescent. Very sol. in H_2O. (Péchard, C. R. **110**. 754.)

Cupric phosphotungstate, $3CuO, 24WO_3, P_2O_5+58H_2O$.

Sol. in H_2O. (Sprenger, J. pr. (2) **22**. 418.)

$2CuO, P_2O_5, 12WO_3+11H_2O$. Very efflorescent. (Péchard, C. R. **110**. 754.)

$2CuO, P_2O_5, 20WO_3+13H_2O$. Efflorescent. (Péchard, A. ch. (6) **22**. 235.)

Lead phosphotungstate, $2PbO, P_2O_5, 12WO_3+6H_2O$.

Insol. in cold, sol. in boiling H_2O. (Péchard, C. R. **110**. 754.)

$2PbO, P_2O_5, 20WO_3+6H_2O$. Sol. in boiling H_2O. (Péchard, A. ch. (6) **22**. 236.)

Lithium phosphotungstate, $Li_2O, P_2O_5, 12WO_3+21H_2O$.

Sol. in H_2O. (Péchard, C. R. **110**. 754.)

Magnesium phosphotungstate, $2MgO, P_2O_5, 12WO_3$.

Sl. efflorescent. (Péchard, C. R. **110**. 754.)

$2MgO, P_2O_5, 20WO_3+19H_2O$. Sl. efflorescent. (Péchard, A. ch. (6) **22**. 234.)

Mercurous phosphotungstate.

Insol. in dil. HNO_3+Aq. (Péchard, C. R. **110**. 754.)

Potassium phosphotungstate, $K_2O, P_2O_5, 12WO_3+9H_2O$.

Insol. in cold, sl. sol. in hot H_2O. (Péchard, C. R. **110**. 754.)

$5K_2O, P_2O_5, 16WO_3+xH_2O=K_5PW_8O_{29}+xH_2O$ (Potassium α-phospholuteotungstate). Very sl. sol. in cold, more easily in hot H_2O. Sol. in cold dil. HNO_3+Aq. (Kehrmann.)

$3K_2O, P_2O_5, 16WO_3+16H_2O=K_3PW_8O_{28}+8H_2O$ (Potassium α-anhydrophospholuteotungstate). Efflorescent. Easily sol. in H_2O. (Kehrmann.)

$K_2O, 5H_2O, P_2O_5, 18WO_3+14H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$6K_2O, P_2O_5, 18WO_3+30H_2O$, and $23H_2O$. The $23H_2O$ salt is more sol. in H_2O than the $30H_2O$ salt. (Gibbs.)

$7K_2O, H_2O, P_2O_5, 20WO_3+27H_2O$. Sol. in H_2O. (Gibbs, B. **10**. 1386.)

$K_2O, P_2O_5, 20WO_3+5H_2O$. Nearly insol. in H_2O. (Péchard, A. ch. (6) **22**. 231.)

$8K_2O, P_2O_5, 20WO_3+18H_2O$. Sl. sol. in H_2O. (Gibbs.)

$3K_2O, P_2O_5, 21WO_3+31H_2O$. Easily sol. in cold H_2O or alcohol. Much less sol. in very dil. HCl+Aq or KCl+Aq. Decomp. by boiling H_2O. (Kehrmann and Freinkel, B. **25.** 1971.)

$2K_2O, 4H_2O, P_2O_5, 22WO_3+2H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$7K_2O, P_2O_5, 22WO_3+31H_2O$. Easily sol. in cold or hot H_2O. Insol. in alcohol. (Kehrmann, B. **25.** 1966.)

$3K_2O, 3H_2O, P_2O_5, 24WO_3+8$, and $14H_2O$. Sol. in a large amount of H_2O with partial decomp. (Gibbs, Proc. Am. Acad. **16.** 120.)

Practically insol. in H_2O. Easily sol. in NH_4OH, alkalies, or alkali carbonates+Aq. (Kehrmann, B. **24.** 2329.)

$6K_2O, P_2O_5, 24WO_3+18H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **15.** 1.)

Potassium lead α-phospho*luteo*tungstate.

Sl. sol. in H_2O. (Kehrmann.)

Silver phosphotungstate, $Ag_2O, P_2O_5, 12WO_3+8H_2O$.

Ppt. Insol. in H_2O. (Péchard, C. R. **110.** 754.)

$5Ag_2O, P_2O_5, 16WO_3+xH_2O=Ag_5PW_8O_{29}+xH_2O$ (Silver α-phospholuteotungstate). Ppt. (Kehrmann.)

$3Ag_2O, P_2O_5, 16WO_3+16H_2O=Ag_3PW_8O_{28}+8H_2O$ (Silver α-anhydrophospholuteotungstate). Easily sol. in H_2O. (Kehrmann.)

$Ag_2O, 24WO_3, P_2O_5+60H_2O$. Insol. in H_2O.

$3Ag_2O, 24WO_3, P_2O_5+58H_2O$. Insol. in H_2O. (Sprenger, J. pr. (2) **22.** 418.)

Sodium phosphotungstate, $3Na_2O, P_2O_5, 7WO_3+Aq$.

Sol. in H_2O. (Kehrmann, Z. anorg. **1.** 437.)

$5Na_2O, 11H_2O, 2P_2O_5, 12WO_3+26H_2O=Na_5H_{11}P_2W_6O_{31}+13H_2O$ (?). (Scheibler, B. **5.** 801.)

$2Na_2O, P_2O_5, 12WO_3+18H_2O$. Sol. in H_2O. Insol. in alcohol. (Péchard, C. R. **110.** 754.)

$5Na_2O, 14WO_3, 2P_2O_5+42H_2O$. Easily sol. in H_2O. (Gibbs.)

$Na_2O, P_2O_5, 20WO_3+23H_2O=Na_2O, 7H_2O, P_2O_5, 20WO_3+16H_2O$. Easily sol. in H_2O. (Gibbs.)

$+25H_2O$. Sl. efflorescent; very sol. in H_2O; insol. in alcohol. (Péchard, A. ch. (6) **22.** 227.)

$2Na_2O, P_2O_5, 20WO_3+10H_2O$. Sol. in H_2O; insol. in alcohol. (Péchard.)

$+30H_2O$. (P.)

$3Na_2O, P_2O_5, 20WO_3+32H_2O$. As above. (P.)

$2Na_2O, P_2O_5, 22WO_3+9H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$3Na_2O, P_2O_5, 24WO_3+22H_2O$. Sol. in H_2O. (Brandhorst and Kraut, A. **249.** 379.)

$2Na_2O, 4H_2O, 24WO_3, P_2O_5+23H_2O$. Readily sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 118.)

Sp. gr. at 20° of solutions of $2Na_2O, 4H_2O, P_2O_5, 24WO_3+23H_2O$ containing:

10·22	20·94	31·14 % salt,
1·085	1·190	1·316
42·61	52·92	64·11 % salt.
1·496	1·702	2·001

or, by calculation, α=sp. gr. if % is crystallised salt, β=sp. gr. if % is anhydrous salt:

	5	10	15	20	25 % salt,
α	1·040	1·084	1·131	1·181	1·237
β	1·044	1·092	1·143	1·199	1·262
	30	35	40	45	50 % salt,
α	1·299	1·370	1·449	1·538	1·640
β	1·333	1·414	1·507	1·613	1·734
	55	60	64 % salt.		
α	1·754	1·884	1·998		
β	1·872	...	...		

(Brandhorst and Kraut, A. **249.** 377.)

Strontium phosphotungstate, $2SrO, P_2O_5, 12WO_3+17H_2O$.

Sol. in H_2O. Insol. in alcohol. (Péchard, C. R. **110.** 754.)

Thallium phosphotungstate, $Tl_2O, P_2O_5, 12WO_3+4H_2O$.

Ppt. (Péchard, C. R. **110.** 754.)

Zinc phosphotungstate, $2ZnO, P_2O_5, 12WO_3+7H_2O$.

Efflorescent. (Péchard, C. R. **110.** 754.)

*Monometa*phosphotungstic acid.

Ammonium *monometa*phosphotungstate, $(NH_4)_2O, 2NH_4PO_3, 18WO_3+11H_2O$.

Sl. sol. in cold H_2O.

Potassium *monometa*phosphotungstate, $3K_2O, 2KPO_3, 24WO_3+20H_2O$.

Very sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 319.)

*Orthometa*phosphotungstic acid.

Potassium sodium *orthometa*phosphotungstate, $2K_2O, 4Na_2O, 6NaPO_3, 6K_3PO_4, 22WO_3+42H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 319.)

*Pyro*phosphotungstic acid.

Ammonium sodium *pyro*phosphotungstate, $6(NH_4)_4P_2O_7, 3Na_4P_2O_7, 2(NH_4)_2O, 22WO_3+31H_2O$.

Nearly insol. in cold H_2O or NH_4OH+Aq. Sol. in a large amount of hot H_2O.

Potassium *pyro*phosphotungstate, $9K_4P_2O_7, 22WO_3+49H_2O$.

Very sl. sol. in cold H_2O.

$6K_4P_2O_7, 3H_4P_2O_7, 22WO_3, K_2O, H_2O+42H_2O$. Sl. sol. in cold. Sol. in much boiling H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Phosphovanadic acid, $P_2O_5, V_2O_5, 2H_2O+9H_2O$.

Sol. in H_2O.

Composition is vanadium phosphate $(VO_2)H_2PO_4+4\frac{1}{2}H_2O$. (Friedheim, B. **23.** 1531.)

This is the only "acid" which exists. (F.)

$P_2O_5, V_2O_5+14H_2O$. Sol. in H_2O; can be recryst. from dil. H_3PO_4+Aq. (Ditte, C. R. **102.** 757.)

$3P_2O_5, 2V_2O_5+9H_2O$. Sol. in H_2O. (Ditte.)

$P_2O_5, 3V_2O_5$. (Berzelius.)

$3H_2O$, $7P_2O_5$, $6V_2O_5+34H_2O$. Sol. in H_2O. Decomp. by much H_2O into—

$6H_2O$, P_2O_5, $20V_2O_5+53H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

Ammonium phosphovanadate, $(NH_4)_2O$, P_2O_5, $V_2O_5+H_2O$.

Sl. sol. in cold H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

$+3H_2O$. Composition is $(VO_2)(NH_4)HPO_4+H_2O$. (Friedheim.)

$(NH_4)_2O$, P_2O_5, $2V_2O_5+7H_2O$. Easily sol. in H_2O. (Gibbs.) Sl. sol. in H_2O. (Friedheim.) Composition is $(NH_4)_2O$, V_2O_5, $+2(VO_2)H_2PO_4+5H_2O$. (Friedheim.)

$5(NH_4)_2O$, $2P_2O_5$, $3V_2O_5+24H_2O$. Easily sol. in H_2O. (Ditte, C. R. **102.** 1019.) Could not be obtained. (Friedheim.)

$5(NH_4)_2O$, $4P_2O_5$, $2V_2O_5+24H_2O$. As above. (Ditte.) Could not be obtained. (Friedheim.)

$7(NH_4)_2O$, P_2O_5, $12V_2O_5+26H_2O$. Easily sol. in H_2O. Composition is $2(NH_4)_2HPO_4+5(NH_4)_2O$, $12V_2O_5+25H_2O$. (Friedheim.)

Potassium phosphovanadate, K_2O, P_2O_5, $2V_2O_5+7H_2O$.

Sl. sol. in H_2O; decomp. thereby to $7K_2O$, $12V_2O_5$, $P_2O_5+26H_2O$.

Composition is K_2O, $V_2O_5+2(VO_2)H_2PO_4+5H_2O$. (Friedheim.)

$3K_2O$, $4P_2O_5$, $6V_2O_5+21H_2O$. Sl. sol. in H_2O. (Gibbs.)

$7K_2O$, P_2O_5, $12V_2O_5+26H_2O$. Easily sol. in H_2O. Composition is $2K_2HPO_4+5K_2O$, $12V_2O_5+25H_2O$. (Friedheim.)

Silver phosphovanadate, $2Ag_2O$, P_2O_5, $V_2O_5+5H_2O$.

Sl. sol. in cold or hot H_2O. (Gibbs.)

Phosphovanadicovanadic acid.

Ammonium phosphovanadicovanadate, $7(NH_4)_2O$, $2P_2O_5$, VO_2, $18V_2O_5+50H_2O$.

Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

$7(NH_4)_2O$, $14P_2O_5$, $16VO_2$, $6V_2O_5+65H_2O$. Decomp. by boiling with H_2O into—

$5(NH_4)_2O$, $10P_2O_5$, $11VO_2$, $V_2O_5+41H_2O$. Sol. in H_2O. (Gibbs.)

Potassium ——, $5K_2O$, $12P_2O_5$, $12VO_2$, $6V_2O_5+40H_2O$.

Decomp. by hot H_2O into—

$7K_2O$, $12P_2O_5$, $14VO_2$, $6V_2O_5+52H_2O$. Sol. in H_2O. (Gibbs.)

Sodium ——, $4Na_2O$, $5P_2O_5$, VO_2, $4V_2O_5+37H_2O$.

Insol. in H_2O. (Gibbs.)

Phosphovanadiomolybdic acid.

Ammonium phosphovanadiomolybdate, $7(NH_4)_2O$, $2P_2O_5$, V_2O_5, $48MoO_3+30H_2O$.

Sl. sol. in cold, somewhat more in hot H_2O with partial decomp. (Gibbs, Am. Ch. J. **5.** 391.)

$8(NH_4)_2O$, P_2O_5, $8V_2O_5$, $14MoO_3+50H_2O$. Easily sol. in hot H_2O without decomp. (Gibbs.)

Phosphovanadiotungstic acid.

Ammonium phosphovanadiotungstate, $10(NH_4)_2O$, $3P_2O_5$, V_2O_5, $60WO_3+60H_2O$.

Nearly insol. in cold, sl. sol. in hot H_2O. Sol. in $(NH_4)_2HPO_4+Aq$, and in NH_4OH+Aq.

$5(NH_4)_2O$, P_2O_5, $3V_2O_5$, $16WO_3+37H_2O$. Easily sol. in H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

Barium ——, $18BaO$, $3P_2O_5$, $2V_2O_5$, $60WO_3+144H_2O$.

Easily sol. in hot H_2O with decomp. (Gibbs, Am. Ch. J. **5.** 391.)

Potassium ——, $3K_2O$, P_2O_5, V_2O_5, $7WO_3+11H_2O$.

Sol. in H_2O.

$8K_2O$, $3P_2O_5$, $4V_2O_5$, $18WO_3+23H_2O$. Sol. in hot H_2O with decomp. into preceding salt. (Gibbs, Am. Ch. J. **5.** 391.)

Phosphovanadiovanadicotungstic acid.

Barium phosphovanadiovanadicotungstate, $18BaO$, $3P_2O_5$, V_2O_5, VO_2, $60WO_3+150H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

Phosphuretted hydrogen.

See **Hydrogen phosphide.**

Platibromonitrous acid.

Potassium platibromonitrite, $K_2Pt(NO_2)_4Br_2$.

Rather sl. sol. in H_2O. (Blomstrand, J. pr. (2) **3.** 214.)

Sol. in about 40 pts. cold, and 20 pts. boiling H_2O. Insol. in alcohol. Sl. sol. in KBr or KNO_2+Aq. (Vèzes, A. ch. (6) **29.** 198.)

$K_2Pt(NO_2)_3Br_3$. Sol. in about 5 pts. warm H_2O with decomp. (Vèzes.)

$K_2Pt(NO_2)_2Br_4$. Sol. in less than 5 pts. H_2O with decomp. (Vèzes.)

Platichloronitrous acid.

Potassium platichloronitrite, $K_2Pt(NO_2)_4Cl_2$.

Rather sl. sol. in H_2O. (Blomstrand, J. pr. (2) **3.** 214.)

Sol. in 40 pts. cold, and 20 pts. boiling H_2O. Insol. in alcohol. Sl. sol. in KCl or KNO_2+Aq. (Vèzes, A. ch. (6) **29.** 183.)

$K_2Pt(NO_2)_3Cl_3$. Very sol. in H_2O. (Vèzes.)

$K_2Pt(NO_2)Cl_5$. Sol. in H_2O with decomp. (Vèzes.)

Platiiodonitrous acid.

Potassium platiiodonitrite, $K_2Pt(NO_2)_2I_4$.

Sl. sol. in cold, more easily in hot H_2O; decomp. by boiling. (Vèzes, A. ch. (6) **29.** 207.)

$K_2Pt(NO_2)I_5$. As above. (Vèzes.)

Platin-.

See also **Platino-, plato-, plat-,** *and* **platos-.**

Platin*di*amine compounds.

See **Chloro-, bromo-, hydroxylo-, iodo-, nitrato-, nitrito-, sulphato-, etc., platin*di*amine compounds.**

Platin*tri*amine carbonate, $Pt(NH_3)_6(CO_3)_2$.
Ppt. Sol. in $NaOH+Aq$. (Gerdes, J. pr. (2) **26**. 257.)

—— **chloride,** $Pt(NH_3)_6Cl_4$.
Sol. in hot H_2O. (Gerdes.)

—— **chloroplatinate,** $Pt(NH_3)_6Cl_4$, $PtCl_4+2H_2O$.
Very sl. sol. in H_2O. (Gerdes.)

—— **nitrate,** $Pt(NH_3)_6(NO_3)_4$.
Easily sol. in H_2O; sl. sol. in HNO_3+Aq. (Gerdes.)

—— **sulphate,** $Pt(NH_3)_6(SO_4)_2+H_2O$.
Nearly insol. in H_2O. (Gerdes.)

***Tetra*platinamine iodide,** $Pt_4(NH_3)_8I_{10}$.
(Blomstrand, B. **16**. 1469.)

***Octo*platinamine iodide,** $Pt_8(NH_3)_{16}I_{18}$.
(Blomstrand.)

Platinic acid.

Barium platinate, basic (?), $3BaO$, $2PtO_2$.
Insol. in $HC_2H_3O_2+Aq$; easily sol. in $HCl+Aq$. (Rousseau.)

Barium platinate, $BaPtO_3$.
(Rousseau, C. R. **109**. 144.)
$+H_2O$. Insol. in dil. HNO_3+Aq; sol. in warm $HCl+Aq$. (Topsoë, B. **3**. 464.)
$+4H_2O$. Very sl. sol. in H_2O, BaO_2H_2, or $NaOH+Aq$. Easily sol. in dil. acids, except $HC_2H_3O_2$, in which it is insol. in the cold, but decomp. on heating. (Topsoë, *l.c.*)
Composition is $3BaPtO_3$, $BaCl_2$, $PtCl_2O+4H_2O$ (?). (Johannsen, A. **155**. 204.)

Calcium platinate chloride (?), $2Ca_2Pt_2O_5Cl_2+7H_2O$ (?).
"Herschel's precipitate."
Easily sol. in $HCl+Aq$, and in HNO_3+Aq, if freshly pptd. (Herschel.)
Very sol. in HNO_3+Aq. (Weiss and Döbereiner, A. **14**. 252.)
Composition is $CaPtO_3$, $PtCl_2O$, $CaO+7H_2O$ (?). (Johannsen, A. **155**. 204.)

Potassium platinate.
Sol. in H_2O. (Berzelius.)

Sodium platinate, Na_2O, $3PtO_2+6H_2O$.
Dil. acids dissolve out Na_2O and leave PtO_2. Sol. in HNO_3+Aq. (Döbereiner, Pogg. **28**. 180.)

Platinimolybdic acid, $4H_2O$, PtO_2, $10MoO_3$.
(Gibbs.)

Silver platinimolybdate.

Sodium ——, $4Na_2O$, PtO_2, $10MoO_3+29H_2O$.
Sol. in H_2O. (Gibbs, Sill. Am. J. (3) **14**. 61.)

Platinitungstic acid.

Ammonium platinitungstate, $4(NH_4)_2O$, PtO_2, $10WO_3+12H_2O$.
Sol. in H_2O. (Gibbs, B. **10**. 1384.)

Potassium platinitungstate, $4K_2O$, PtO_2, $10WO_3+9H_2O$.
Sol. in H_2O. (Gibbs.)

Sodium ——, $4Na_2O$, PtO_2, $10WO_3+25H_2O$.
Sol. in H_2O. (Gibbs.)
$5Na_2O$, $7WO_3$, $2PtO_2+35H_2O$. Sol. in H_2O. (Gibbs.)
Is double salt $3Na_2O$, $7WO_3+2Na_2PtO_3$. (Rosenheim, B. **24**. 2397.)

Platino-.
See also **Plato-.**

Platinochlorophosphoric acid.
See **Chloroplatinophosphoric acid.**

Platinocyanhydric acid, $H_2Pt(CN)_4$.
Deliquescent. Very sol. in H_2O, alcohol, and ether.

Ammonium platinocyanide, $(NH_4)_2Pt(CN)_4+3H_2O$.
Very sol. in H_2O.
$+2H_2O$. Sol. in 1 pt. H_2O, and still more easily in alcohol.
$+H_2O$.

Ammonium hydroxylamine platinocyanide, $NH_4(NH_4O)Pt(CN)_4+3\frac{1}{2}H_2O$.
Sol. in H_2O. (Scholz, M. Ch. **1**. 900.)

Ammonium magnesium platinocyanide, $(NH_4)_2Mg[Pt(CN)_4]_2+6H_2O$.

Barium platinocyanide, $BaPt(CN)_4+4H_2O$.
Sol. in 33 pts. H_2O at 16°, and in much less at 100°. Sol. in alcohol.

Barium potassium platinocyanide, $BaK_2[Pt(CN)_4]_2$.
Sol. in H_2O.

Barium rubidium platinocyanide, $BaRb_2[Pt(CN)_4]_2$.
Sol. in H_2O.

Cadmium platinocyanide, $CdPt(CN)_4$.
Ppt. Sol. in NH_4OH+Aq. (Martius, A. **117**. 376.)
$CdPt(CN)_4$, $2NH_3+H_2O$. (M.)

Calcium platinocyanide, $CaPt(CN)_4+5H_2O$.
Very sol. in H_2O.

Calcium potassium platinocyanide, $CaK_2[Pt(CN)_4]_2$.
Sol. in H_2O.

Cerium platinocyanide, $Ce_2[Pt(CN)_4]_3+18H_2O$.
Sol. in H_2O.

Cobaltous platinocyanide ammonia, $CoPt(CN)_4$, $2NH_3$.
Insol. in H_2O, but sol. in hot NH_4OH+Aq.

Cupric platinocyanide, $CuPt(CN)_4+xH_2O$.
Ppt.

Cupric platinocyanide ammonia, $CuPt(CN)_4$, $2NH_3+H_2O$.
$CuPt(CN)_4$, $4NH_3$. Sol. in H_2O, alcohol, and ether.

Didymium platinocyanide, $Di_2[Pt(CN)_4]_3+18H_2O$.

Efflorescent in dry air. Sol. in H_2O. (Cleve.)

Erbium platinocyanide, $Er_2[Pt(CN_4)]_3+21H_2O$.

Sol. in H_2O. (Cleve.)

Hydroxylamine platinocyanide, $(NH_4O)_2Pt(CN)_4+2H_2O$.

Deliquescent. Very sol. in H_2O. (Scholz.)

Hydroxylamine lithium platinocyanide, $(NH_4O)LiPt(CN)_4+3H_2O$.

Sol. in H_2O.

Lanthanum platinocyanide, $La_2[Pt(CN)_4]_3+18H_2O$.

Easily sol. in H_2O. (Cleve.)

Magnesium platinocyanide, $MgPt(CN)_4+7H_2O$.

Sol. in 3·4 pts. H_2O at 16°. Easily sol. in alcohol and ether.

$+2H_2O$.

$+5H_2O$.

Magnesium potassium platinocyanide, $MgK_2[Pt(CN)_4]_2+7H_2O$.

Sol. in H_2O.

Mercuric platinocyanide, $HgPt(CN)_4$.

Ppt.

Mercuric platinocyanide nitrate, $5HgPt(CN)_4$, $Hg(NO_3)_2+10H_2O$.

Ppt.

Nickel platinocyanide ammonia, $NiPt(CN)_4$, $2NH_3+H_2O$.

Potassium platinocyanide, $K_2Pt(CN)_4+3H_2O$.

Extremely efflorescent. Sl. sol. in cold, easily in hot H_2O. (Willm, B. **19.** 950.)

Sol. in alcohol and ether.

Potassium sodium platinocyanide, $K_2Pt(CN)_4$, $Na_2Pt(CN)_4+6H_2O$.

Sol. in H_2O. (Willm, B. **19.** 950.)

Samarium platinocyanide, $Sm_2[Pt(CN_4)]_3+18H_2O$.

Sol. in H_2O. (Cleve.)

Silver platinocyanide, $Ag_2Pt(CN)_4$.

Insol. in H_2O. Sol. in NH_4OH+Aq.

Silver platinocyanide ammonia, $Ag_2Pt(CN)_4$, $2NH_3$.

Sol. in NH_4OH+Aq.

Sodium platinocyanide, $Na_2Pt(CN)_4+3H_2O$.

Easily sol. in H_2O. (Willm, Z. anorg. **4.** 298.)

Sol. in alcohol.

Strontium platinocyanide, $SrPt(CN)_4+5H_2O$.

Sol. in H_2O.

Thallous platinocyanide, $Tl_2Pt(CN)_4$.

Nearly insol. in cold, sl. sol. in hot H_2O. (Friswell, Chem. Soc. **24.** 461.)

Thallous platinocyanide carbonate, $2Tl_2Pt(CN)_4$, Tl_2CO_3.

Nearly insol. in cold H_2O. (F.)

Thorium platinocyanide, $Th[Pt(CN)_4]_2+16H_2O$.

Somewhat difficultly sol. in cold, easily in hot H_2O. (Cleve, Sv. V. A. H. Bih. **2.** No. 6.)

Yttrium platinocyanide, $Y_2[Pt(CN)_4]_3+21H_2O$.

Easily sol. in H_2O. Insol. in absolute alcohol. (Cleve and Höglund.)

Zinc platinocyanide ammonia, $ZnPt(CN)_4$, $2NH_3+H_2O$.

Platinonitrous acid.

See **Platonitrous acid.**

Platinoselenostannic acid.

See under **Selenostannate, platinum.**

Platinososulphocyanhydric acid, $H_2Pt(SCN)_4$.

Known only in aqueous solution.

Potassium platinososulphocyanide, $K_2Pt(SCN)_4$.

Permanent. Sol. in 2·5 pts. H_2O at 15°, and more readily at higher temp. Very sol. in warm alcohol.

Silver ——, $Ag_2Pt(SCN)_4$.

Insol. in H_2O. Sol. in $KSCN+Aq$, and partly sol. in NH_4OH+Aq.

Platinosulphocyanhydric acid, $H_2Pt(SCN)_6$.

Known only in aqueous, and alcoholic solutions.

Ammonium platinosulphocyanide, $(NH_4)_2Pt(SCN)_6$.

Sol. in H_2O and alcohol.

Barium ——, $BaPt(SCN)_6$.

Sol. in H_2O and alcohol.

Ferrous ——, $FePt(SCN)_6$.

Insol. in H_2O or alcohol. Not attacked by dil. H_2SO_4, HCl, or HNO_3+Aq.

Lead ——, $PbPt(SCN)_6$.

Sl. sol. in cold, decomp. by hot H_2O. Sol. in alcohol.

$PbPt(SCN)_6,PbO$. Insol. in H_2O or alcohol. Sol. in acetic or nitric acids.

Mercurous ——, $Hg_2Pt(SCN)_6$.

Ppt. Insol. in H_2O.

Potassium ——, $K_2Pt(SCN)_6$.

Sol. in 12 pts. H_2O at 15°. Much more easily in hot H_2O, and still more easily in hot alcohol.

Silver ——, $Ag_2Pt(SCN)_6$.

Insol. in H_2O or $K_2Pt(SCN)_6+Aq$. Sol. in cold NH_4OH+Aq and in $KCNS+Aq$.

Sodium ——, $Na_2Pt(SCN)_6$.

Sol. in H_2O and alcohol.

Platinosulphostannic acid.

See under **Sulphostannate, platinum.**

Platinosulphurous acid.

See **Platosulphurous acid.**

Platinum, Pt.

Not attacked by H_2O, H_2SO_4, HCl, or HNO_3+Aq. Slowly sol. in aqua regia, or a mixture of HBr and HNO_3, but much less easily than Au.

HCl+HNO_3, so long as they are sufficiently dil. or the temperature is so low that they cannot react on each other, have no action on Pt. Addition of Cl does not bring about reaction, but a few drops of KNO_2 or N_2O_3+Aq bring about an immediate reaction. (Millon.)

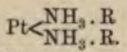
Slowly sol. in HI+Aq. (Deville, C. R. **42.** 896.)

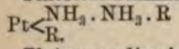
Slowly sol. in boiling $FeCl_3$+Aq. (Saint-Pierre, C. R. **54.** 1077.)

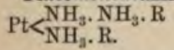
Sl. sol. in conc. H_2SO_4 containing small amounts of nitrogen oxides. (Scheurer-Kestner, C. R. **86.** 1082.)

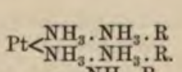
Platinum ammonium compounds.

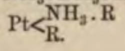
See—

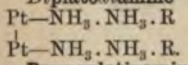
Platosamine comps., 
$\mathrm{Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

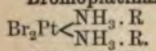
Plato*semidi*amine comps.,

$\mathrm{Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{R.}\end{matrix}$

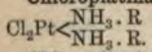
Plato*monodi*amine comps.,

$\mathrm{Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

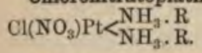
Plato*di*amine comps., 
$\mathrm{Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.NH_3.R.}\end{matrix}$

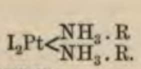
Platoso*semi*amine comps., 
$\mathrm{Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{R.}\end{matrix}$

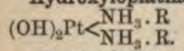
***Di*plato*di*amine comps.,**

$\begin{matrix}\mathrm{Pt{-}NH_3.NH_3.R}\\|\\\mathrm{Pt{-}NH_3.NH_3.R.}\end{matrix}$

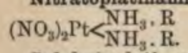
Bromoplatinamine comps.,

$\mathrm{Br_2Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

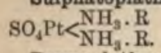
Chloroplatinamine comps.,

$\mathrm{Cl_2Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Chloronitratoplatinamine comps.,

$\mathrm{Cl(NO_3)Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Iodoplatinamine comps., 
$\mathrm{I_2Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Hydroxyloplatinamine comps.,

$\mathrm{(OH)_2Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Nitratoplatinamine comps.,

$\mathrm{(NO_3)_2Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Sulphatoplatinamine comps.,

$\mathrm{SO_4Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Bromoplatin*semidi*amine comps.,
$Br_3PtNH_3.NH_3.R.$

Bromonitritoplatin*semidi*amine comps.,
$Br_2(NO_2)PtNH_3.NH_3.R.$

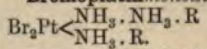
Chloroplatin*semidi*amine comps.,
$Cl_3PtNH_3.NH_3.R.$

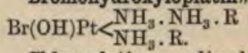
Chlorohydroxylonitrito*semidi*amine comps.,
$Cl(OH)(NO_2)PtNH_3.NH_3.R.$

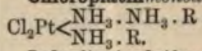
Chloronitritoplatin*semidi*amine comps.,
$Cl_2(NO_2)PtNH_3.NH_3.R.$

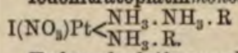
Iodoplatin*semidi*amine comps.,
$I_3PtNH_3.NH_3.R.$

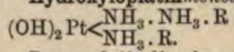
Hydroxylo*semidi*amine comps.,
$(OH)_3PtNH_3.NH_3.R.$

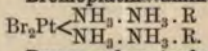
Bromoplatin*monodi*amine comps.,

$\mathrm{Br_2Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

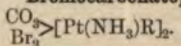
Bromohydroxyloplatin*monodi*amine comps.,

$\mathrm{Br(OH)Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Chloroplatin*monodi*amine comps.,

$\mathrm{Cl_2Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Iodonitratoplatin*monodi*amine comps.,

$\mathrm{I(NO_3)Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Hydroxyloplatin*monodi*amine comps.,

$\mathrm{(OH)_2\,Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}$

Bromoplatin*di*amine comps.,

$\mathrm{Br_2Pt}<\begin{matrix}\mathrm{NH_3.NH_3.R}\\\mathrm{NH_3.NH_3.R.}\end{matrix}$

Bromocarbonatoplatin*di*amine comps.,

$\begin{matrix}\mathrm{CO_3}\\\mathrm{Br_2}\end{matrix}>\mathrm{[Pt(NH_3)R]_2.}$

Bromochloroplatin*di*amine comps.,
$BrClPt(NH_3)_4R_2.$

Bromohydroxyloplatin*di*amine comps.,
$Br(OH)Pt(NH_3)_4R_2.$

Bromonitratoplatin*di*amine comps.,
$Br(NO_3)Pt(NH_3)_4R_2.$

Bromosulphatoplatin*di*amine comps.,
$Br_2(SO_4)[Pt(NH_3)_4R_2]_2.$

Carbonatochloroplatin*di*amine comps.,
$(CO_3)Cl_2[Pt(NH_3)_4R_2]_2.$

Carbonatonitratoplatin*di*amine comps.,
$(CO_3)(NO_3)_2[Pt(NH_3)_4R_2]_2.$

Chloroplatin*di*amine comps., $Cl_2Pt(NH_3)_4R_2.$

Chlorohydroxyloplatin*di*amine comps.,
$Cl(OH)(NH_3)_4R_2.$

Chloroiodoplatin*di*amine comps.,
$ClIPt(NH_3)_4R_2.$

Chloronitratoplatin*di*amine comps.,
$Cl(NO_3)Pt(NH_3)_4R_2.$

Hydroxyloplatin*di*amine comps.,
$(OH)_2Pt(NH_3)_4R_2.$

Hydroxylonitrato*di*amine comps.,
$(OH)(NO_3)Pt(NH_3)_4R_2.$

Hydroxylosulphato*di*amine comps.,
$(OH)_2SO_4[Pt(NH_3)_4R_2]_2.$

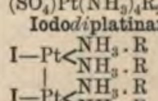
Iodoplatin*di*amine comps., $I_2Pt(NH_3)_4R_2.$

Iodonitritoplatin*di*amine comps.,
$I(NO_2)Pt(NH_3)_4R_2.$

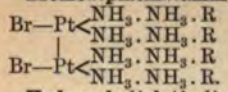
Nitratoplatin*di*amine comps.,
$(NO_3)_2Pt(NH_3)_4R_2.$

Nitritoplatin*di*amine comps.,
$(NO_2)_2Pt(NH_3)_4R_2.$

Sulphatoplatin*di*amine comps.,
$(SO_4)Pt(NH_3)_4R_2.$

Iodo*di*platinamine comps.,

$\begin{matrix}\mathrm{I{-}Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R}\end{matrix}\\|\\\mathrm{I{-}Pt}<\begin{matrix}\mathrm{NH_3.R}\\\mathrm{NH_3.R.}\end{matrix}\end{matrix}$

Bromo*di*platin*di*amine comps.,



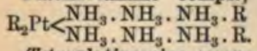
$$\begin{array}{l}\mathrm{Br{-}Pt}{<}\begin{array}{l}\mathrm{NH_3.NH_3.R}\\ \mathrm{NH_3.NH_3.R}\end{array}\\ \qquad | \\ \mathrm{Br{-}Pt}{<}\begin{array}{l}\mathrm{NH_3.NH_3.R}\\ \mathrm{NH_3.NH_3.R.}\end{array}\end{array}$$

Hydroxylo*di*platin*di*amine comps., $(OH)_2Pt_2(NH_3)_8R_4$.

Iodo*di*platin*di*amine comps., $I_2Pt_2(NH_3)_8R_4$.

Nitrato*di*platin*di*amine comps., $(NO_3)_2Pt_2(NH_3)_8R_4$.

Platin*tri*amine comps.,



$$\mathrm{R_2Pt}{<}\begin{array}{l}\mathrm{NH_3.NH_3.NH_3.R}\\ \mathrm{NH_3.NH_3.NH_3.R.}\end{array}$$

***Tetra*platinamine comps.,** $Pt_4(NH_3)_8R_{10}$.

***Octo*platinamine comps.,** $Pt_8(NH_3)_{16}R_{18}$.

Platinum antimonide, $PtSb_2$.

(Christofle, **1863.**)

Platinum arsenide, Pt_3As_2.

(Tivoli, Gazz. ch. it. **14.** 487.)

$PtAs_2$. Min. *Sperrylite.* Sl. attacked by aqua regia. (Wells, Sill. Am. J. (3) **37.** 67.)

Platinum arsenic hydroxide (?), PtAsOH.

Insol. in, and slowly decomp. by H_2O and alcohol. Easily decomp. by HCl + Aq; not attacked by HNO_3 + Aq. Sol. in aqua regia; not attacked by cold conc. H_2SO_4, but decomp. on heating. (Tivoli, Gazz. ch. it. **14.** 487.)

Platinum boride, Pt_2B_2.

Very slowly sol. in aqua regia. (Martius, A. **109.** 79.)

Platinous bromide, $PtBr_2$.

Insol. in H_2O. Sol. in HBr + Aq. Sl. sol. in KBr + Aq. (Topsoë, J. B. **1868.** 274.)

Platinic bromide, $PtBr_4$.

Not deliquescent; sol. in H_2O. (Meyer and Züblin, B. **13.** 404.)

Sl. sol. in H_2O. 100 g. $PtBr_4$ + Aq sat. at 20° contain 0·41 g. $PtBr_4$. (Halberstadt, B. **17.** 2962.)

Easily sol. in HBr + Aq; sl. sol. in $HC_2H_3O_2$ + Aq. Sol. in considerable amount in K or NH_4 oxalate + Aq.

Very sl. sol. in alcohol or ether, also in glycerine. (Halberstadt.)

Platinic hydrogen bromide.

See **Bromoplatinic acid.**

Platinous bromide carbonyl.

See **Carbonyl platinous bromide.**

Platinic bromide ***with*** **MBr.**

See **Bromoplatinate, M.**

Platinum carbide, PtC_2.

Hot aqua regia dissolves out nearly all the Pt. (Zeise, J. pr. **20** 209.)

Platinum carbon ***di*****sulphide,** $PtCS_2$.

See **Platinum sulphocarbide.**

Platinous chloride, $PtCl_2$.

Insol. in H_2O, conc. H_2SO_4, or HNO_3. Sol. in hot HCl + Aq with exclusion of air. (Berzelius.)

Insol. in alcohol or ether; sol. in NH_4OH + Aq. (Raewsky, A. ch. (3) **22.** 280.) Sol. in aqua regia with formation of $PtCl_4$.

Insol. in cold conc. KI + Aq, but sol. when heated. (Lassaigne, A. ch. (2) **51.** 117.)

Platinic chloride, $PtCl_4$.

Not deliquescent. Very sol. in H_2O. (Pullinger, Chem. Soc. **61.** 420.)

$+5H_2O$. Not deliquescent. Sol. in H_2O or HCl + Aq.

Composition is probably $H_2PtCl_4O + 4H_2O$. (Norton, J. pr. **110.** 469.)

Sp. gr. of aqueous solution containing:

5	10	15	20	25	% $PtCl_4$,
1·046	1·097	1·153	1·214	1·285	
30	35	40	45	50	% $PtCl_4$.
1·362	1·450	1·546	1·666	1·785	

(Precht, Z. anal. **18.** 512.)

Sol. in alcohol and ether; sol. in anhydrous acetone. (Zeise, A. **33.** 34.)

Insol. in conc. H_2SO_4. (Dumas.)

$+4H_2O$. (Engel, Bull. Soc. (2) **50.** 102.)

Platinous hydrogen chloride.

See **Chloroplatinous acid.**

Platinic hydrogen chloride.

See **Chloroplatinic acid.**

Platinous chloride ***with*** **MCl.**

See **Chloroplatinite, M.**

Platinic chloride ***with*** **MCl.**

See **Chloroplatinate, M.**

Platinous phosphorus chloride.

See **Phosphorus platinous chloride.**

Platinic phosphorus chloride.

See **Phosphorus platinic chloride.**

Platinous chloride carbonyl.

See **Carbonyl platinous chloride.**

Platinum chloroiodide, $PtCl_2I_2$.

Very deliquescent. (Kämmerer, A. **148.** 329.)

$PtCl_3I$. Insol. in H_2O. Sl. sol. in alcohol. Sol. in KOH + Aq, from which it is pptd. by H_2SO_4. (Mather, Sill. Am. J. **27.** 257.)

Platinum chloronitride, PtNCl.

(Alexander, C. C. **1887.** 1254.)

Platinous cyanide ***with*** **MCN.**

See **Platinocyanide, M.**

Platinous fluoride, PtF_2 (?).

Insol. in H_2O. (Moissan, A. ch. (6) **24.** 287.)

Platinic fluoride, PtF_4.

Deliquescent. Sol. in H_2O, with immediate decomp. into PtO_4H_4 and HF. (Moissan, C. R. **109.** 807.)

Platinous hydroxide, PtO_2H_2.

Sol. in HCl, HBr, and H_2SO_3 + Aq, but not in other oxygen acids. Decomp. by boiling KOH + Aq. (Thomsen, J. pr. (2) **16.** 344.)

Platinic hydroxide, $Pt(OH)_4$.

Easily sol. in dil. acids and in $NaOH+Aq$. (Topsoë, J. B. **1870**. 386.)

Nearly insol. in acetic acid. (Döbereiner.)

$+H_2O$. Ppt. (Prost, Bull. Soc. (2) **44**. 256.)

$+2H_2O$. Easily sol. in dil. acids, even acetic acid, and in $NaOH+Aq$. (Topsoë.)

Platinoplatinic hydroxide, Pt_3O_4, $9H_2O$.

Ppt. (Prost, Bull. Soc. (2) **46**. 156.)

Pt_5O_{11}, $11H_2O$. Ppt. (Prost.)

Platinum hydroxylamine comps.

See—

Plato*di*oxamine comps., $Pt(NH_3O)_4R_2$.

Platosoxamine comps., $Pt(NH_3O)_2R_2$.

Platosoxamine-amine comps., $Pt(NH_3O)_3NH_3R_2$.

Platinous iodide, PtI_2.

Insol. in H_2O, acids, or alcohol. (Lassaigne, A. ch. (2) **51**. 113.)

Difficultly sol. in Na_2SO_3+Aq. (Topsoë.)

Gradually decomp. by hot $HI+Aq$ of 1·038 sp. gr., also by hot $KI+Aq$, PtI_4 being dissolved out and Pt left behind. Not attacked by conc. H_2SO_4, HCl, or HNO_3+Aq, but gradually decomp. by KOH or $NaOH+Aq$. (Lassaigne.)

Platinic iodide, PtI_4.

Insol. in H_2O. Sol. in NaOH or Na_2CO_3+Aq, H_2SO_3, or Na_2SO_3+Aq. Sol. in $HI+Aq$ or alkali iodides $+Aq$. Sol. in alcohol, with partial decomp. Not attacked by acids. (Lassaigne, A. ch. (2) **51**. 122.)

Not obtained in a pure state. (Topsoë, C. C. **1870**. 683.)

Platinic iodide *with* MI.

See **Iodoplatinate, M.**

Platinum nitride chloride, PtNCl.

See **Platinum chloronitride.**

Platinous oxide, PtO.

Sol. in H_2SO_3+Aq. Insol. in other acids. (Döbereiner, Pogg. **28**. 183.)

Sol. in conc. H_2SO_4; easily in conc. $HCl+Aq$. (Storer's Dict.)

Platinic oxide, PtO_2.

Insol. in acids.

Platinoplatinic oxide, Pt_3O_4.

Not attacked by long boiling with HCl, HNO_3, or aqua regia. (Jörgensen, J. pr. (2) **16**. 344.)

Platinum oxychloride, 3PtO, $PtCl_2$ (?).

Sol. in HCl, and in $KOH+Aq$. (Kane, Phil. Trans. **1842**. 298.)

$PtCl_2(OH)_2=H_2PtCl_2O_2$. (Jörgensen, J. pr. (2) **16**. 345.)

Platinum oxysulphide, PtOS.

See **Platinum sulphydroxide.**

Platinum phosphide, PtP_2.

Insol. in $HCl+Aq$. Sol. in aqua regia. (Schrötter, W. A. B. **1849**. 303.)

PtP_2H_2. Sol. in H_2O, and $HCl+Aq$. (Cavazzi, Gazz. ch. it. **13**. 324.)

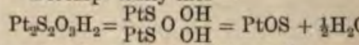
Pt_3P_5. Partially sol. in aqua regia. (Clark and Joslin, C. N. **48**. 385.)

PtP. Insol. in aqua regia. (Clark and Joslin.)

Pt_2P. Sol. in aqua regia. (Clark and Joslin.)

Platinum sulphydroxide, $PtOS+H_2O=PtS(OH)_2$.

Decomp. easily into—



$$Pt_2S_2O_3H_2=\begin{matrix}PtS\\PtS\end{matrix}O\begin{matrix}OH\\OH\end{matrix}=PtOS+\tfrac{1}{2}H_2O.$$

H_2O cannot be removed without decomposing the compound. (v. Meyer, J. pr. (2) **15**. 1.)

Platinous sulphide, PtS.

Not attacked by boiling acids, aqua regia, or $KOH+Aq$. (Böttger, J. pr. **2**. 274.)

Sol. in large excess of $(NH_4)_2S+Aq$.

Platinoplatinic sulphide, Pt_2S_3.

Not attacked by HCl or HNO_3+Aq, and only slowly by aqua regia. (Schneider, Pogg. **138**. 607.)

Platinic sulphide, PtS_2.

Anhydrous. Aqua regia attacks sl., other acids not at all. (Davy.)

Hydrated. Insol. in $HCl+Aq$; sl. sol. in boiling HNO_3+Aq. Sol. in aqua regia. (Fresenius.) Sol. in alkali sulphides, hydrates and carbonates $+Aq$. (Berzelius.) Very sl. sol. in $(NH_4)_2S+Aq$. (Claus.)

Insol. in NH_4Cl, or NH_4NO_3+Aq.

1 pt. $PtCl_4$ in 100 pts. H_2O+25 pts. HCl is not pptd. by H_2S. (Reinsch.)

Difficultly sol. in alkali sulphydroxides + Aq, but more easily in presence of SnS, Sb_2S_3, As_2S_3, or SnS_2. (Riban, C. R. **85**. 283.)

Platinum sulphide, Pt_5S_6, *or Tetra***platinum sulphoplatinate**, 4PtS, PtS_2.

Decomp. on moist air, but not attacked by acids. (Schneider, J. pr. (2) **7**. 214.)

Platinum sulphides *with* M_2S.

See **Sulphoplatinate, M.**

Platinum sulphocarbide, $PtCS_2$.

Attacked by hot HCl, HNO_3+Aq, or aqua regia. (Schützenberger, C. R. **111**. 391.)

Plato-.

See also **Platino-.**

Plato*di*amine bromide, $Pt[(NH_3)_2Br]_2+3H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **carbonate**, $Pt(N_2H_6)_2CO_3+H_2O$.

Sol. in H_2O. (Peyrone, A. **51**. 14.)

$Pt(N_2H_6CO_3H)_2$. Sl. sol. in, but decomp. by boiling with H_2O into—

—— ***sesqui*carbonate.**

More sol. than preceding salt. (Reiset, C. R. **11**. 711.)

—— **chloride**, $Pt[(NH_3)_2Cl]_2+H_2O$.

"Reiset's first chloride." Sol. in 4 pts.

H_2O at 16·5°, and in less hot H_2O. Insol. in alcohol or ether. (Reiset, A. ch. (3) **11.** 419.)

As sol. in NH_4Cl+Aq as in H_2O; insol. in absolute alcohol; sl. sol. in dil. alcohol; very sol. in dil. $HCl+Aq$. (Peyrone, A. ch. (3) **12.** 196.)

Plato*di*amine cuprous chloride, $Pt(NH_3)_4Cl_2$, Cu_2Cl_2.

Sol. in H_2O, and pptd. from H_2O solution by alcohol. (Buckton.)

—— **cupric chloride,** $Pt(NH_3)_4Cl_2$, $CuCl_2$.

Sl. sol. in cold, decomp. by hot H_2O into $Pt(NH_3)_4Cl_2$, Cu_2Cl_2. (Buckton, Chem. Soc. **5.** 218.)

Nearly insol. in H_2O; easily sol. in warm $HCl+Aq$; insol. in alcohol. (Millon and Commaille, C. R. **57.** 822.)

Millon and Commaille's salt is $Cu(NH_3)_4Cl_2$, $PtCl_2$, cuprammonium chloroplatinite.

—— **lead chloride,** $Pt(NH_3)_4Cl_2$, $PbCl_2$.

Sol. in hot, much less in cold H_2O. Insol. in $HCl+Aq$ or alcohol. (Buckton, Chem. Soc. **5.** 213.)

—— **mercuric chloride,** $Pt(NH_3)_4Cl_2$, $HgCl_2$.

Easily sol. in hot H_2O, much less in cold. Insol. in $HCl+Aq$. (Buckton.)

—— **zinc chloride,** $Pt(NH_3)_4Cl_2$, $ZnCl_2$.

Easily sol. in hot H_2O. Insol. in alcohol. (Buckton.)

—— **chloroplatinate,** $Pt(NH_3)_4Cl_2$, $PtCl_4$.

Ppt. Insol. in H_2O. (Cossa, Gazz. ch. it. **17.** 1.)

—— **chloroplatinite,** $Pt(NH_3)_4Cl_2$, $PtCl_2$.

(Magnus' green salt.) Insol. in, and not decomp. by H_2O, $HCl+Aq$, or alcohol. (Magnus.)

Slowly sol. in boiling NH_4OH+Aq and in conc. NH_4 salts$+Aq$. (Reiset, A. ch. (3) **11.** 427.)

Almost as sol. in $(NH_4)_2CO_3+Aq$ as in NH_4OH+Aq. Sol. in hot $PtCl_4+Aq$. (Reiset.)

Not decomp. by boiling KOH, dil. HCl, or H_2SO_4+Aq, but easily by HNO_3+Aq. (Gros, A. **27.** 245.)

—— **chromate,** $Pt(NH_3)_4CrO_4$.

Scarcely sol. in H_2O. (Cleve.)

—— ***di*chromate,** $Pt(NH_3)_4Cr_2O_7$.

Sl. sol. in H_2O. Insol. in alcohol. Sol. in $KOH+Aq$. (Buckton, Chem. Soc. **5.** 213.)

—— **platinous cyanide,** $Pt(NH_3)_4(CN)_2$, $Pt(CN)_2$.

Sl. sol. in cold, easily in boiling H_2O; sol. in KOH, HCl, and dil. H_2SO_4+Aq without decomp., but conc. H_2SO_4 decomposes.

—— **potassium ferrocyanide,**
$Pt(NH_3)_4K_2[Fe(CN)_6]_2+3H_2O$.

—— **hydroxide,** $Pt[(NH_3)_2OH]_2$.

"Reiset's first base." Easily sol. in H_2O. Sl. sol. in alcohol.

—— **iodide,** $Pt[(NH_3)_2I]_2$.

Sl. sol. in cold, more easily in hot H_2O, but slowly decomp. on boiling. (Reiset.)

Plato*di*amine nitrate, $Pt[(NH_3)_2NO_3]_2$.

Sol. in about 10 pts. boiling H_2O. Insol. or but sl. sol. in alcohol. (Peyrone, A. ch. (3) **12.** 203.)

—— **nitrate sulphate,** $[Pt(NH_3)_4NO_3]_2SO_4$, $Pt(NH_3)_4SO_4$.

Very easily sol. in H_2O. (Carlgren, Sv. V. A. F. **47.** 310.)

—— **nitrite,** $Pt[(NH_3)_2NO_2]_2+2H_2O$.

Efflorescent. Very sol. in hot or cold H_2O. Insol. in 90 % alcohol. (Lang.)

—— **platinous nitrite,** $Pt[(NH_3)_2NO_2]_2$, $Pt(NO_2)_2$.

Scarcely sol. in cold, somewhat more easily in hot H_2O. Not attacked by cold dil. acids. More sol. in NH_4OH+Aq than in H_2O. (Lang.)

—— **phosphate,** $Pt(N_2H_6)_2HPO_4+H_2O$.

Rather difficultly sol. in cold, and very easily in hot H_2O. (Cleve.)

—— **ammonium phosphate,**
$Pt[(N_2H_6)PO_4(NH_4)_2]_2$, $4NH_4H_2PO_4+H_2O$.

Very easily sol. in H_2O with decomp. into—$Pt(N_2H_6H_2PO_4)_2$, $2NH_4H_2PO_4+9H_2O$. Much more sol. in H_2O than the preceding comp. (Cleve.)

—— **sulphate,** $Pt(NH_3)_4SO_4$.

Sol. in 32 pts. H_2O at 16·5°; more easily when heated. (Reiset.)

Sol. in 50-60 pts. boiling H_2O; less in cold H_2O; insol. in alcohol. (Cleve.)

—— **sulphate, acid,**
$Pt[(NH_3)_2SO_4H]_2+H_2O$.

Decomp. by H_2O or alcohol into neutral salt.

$3Pt(NH_3)_4SO_4$, $H_2SO_4+H_2O$. Sol. in H_2O. (Cleve.)

—— **sulphite,** $Pt(NH_3)_4SO_3$.

Nearly insol. in cold H_2O. (Birnbaum, A. **152.** 143.)

$Pt[(NH_3)_2SO_3H]_2+2H_2O$. Ppt. Sol. in $HCl+Aq$. (Cleve.)

—— **platinous sulphite,**
$3Pt(NH_3)_4SO_3$, $PtSO_3+2H_2O$.

Scarcely sol. in cold H_2O; sol. in 190 pts. H_2O at 100°. Easily sol. in warm $HCl+Aq$ with decomp. (Peyrone.)

$+4H_2O$. (Carlgren, Sv. V. A. F. **47.** 308.)

$2Pt(NH_3)_4SO_3$, $PtSO_3$, H_2SO_3 Insol. in cold H_2O or alcohol. Scarcely sol. in hot H_2O. (Peyrone.)

—— **sulphocyanide,** $Pt(NH_3)_4(CNS)_2+H_2O$.

Very sol. in H_2O. Solution is decomp. on boiling. (Cleve, Sv. V. A. H. **10,** **9.** 7.)

—— **platinous sulphocyanide,**
$Pt(NH_3)_4(CNS)_2$, $Pt(CNS)_2$.

Insol. in H_2O and alcohol; sol. in dil. $HCl+Aq$. (Buckton, Chem. Soc. **13.** 122.)

Plato*monodi*amine chloride, $Pt\genfrac{}{}{0pt}{}{(NH_3)_2Cl}{NH_3Cl}$.

Easily sol. in H_2O. (Cleve.)

Plato*monodi*amine chloroplatinite
$2\mathrm{Pt}\genfrac{}{}{0pt}{}{(NH_3)_2Cl}{NH_3Cl}, PtCl_2$.

Moderately sol. in cold, but more easily in hot H_2O. (Cleve.)

—— **nitrate,** $\mathrm{Pt}\genfrac{}{}{0pt}{}{(NH_3)_2NO_3}{NH_3NO_3} + H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **sulphate,** $\mathrm{Pt}\genfrac{}{}{0pt}{}{(NH_3)_2}{NH_3}SO_4$.

Easily sol. in cold, but much more in hot H_2O.

Plato*semidi*amine bromide, $\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2Br}{Br}$.

Sol. in H_2O. Easily sol. in NH_4OH+Aq. (Cleve.)

—— **chloride,** $\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2Cl}{Cl}$.

(Peyrone's chloride.) Sol. in 387 pts. H_2O at 0°, and 26 pts. at 100° (Cleve); in 33 pts. at 100° (Peyrone).

Sol. in NH_4OH+Aq; very sl. sol. in HCl or H_2SO_4+Aq; more easily in HNO_3+Aq; sol. in alkali carbonates+Aq. (Peyrone, A. ch. (3) **12**. 193.)

Plato*semidi*amine chlorosulphurous acid,
$\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2SO_3H}{Cl}$.

Easily sol. in H_2O. (Cleve.)

Ammonium plato*semidi*amine chlorosulphite plato*semidi*amine sulphite,
$\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2SO_3NH_4}{Cl}, \mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2SO_3NH_4}{SO_3NH_4} + 2H_2O$.

Easily sol. in H_2O. Insol. in alcohol. (Cleve.)

Plato*semidi*amine cyanide,
$Pt(CN)(NH_3)_2CN$.

Easily sol. in H_2O. (Cleve.)

—— **platinous cyanide,** $Pt(CN)(NH_3)_2CN, Pt(CN)_2$ (?).

Ppt.

—— **hydroxide,** $\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2OH}{OH}$.

Not known.

—— **iodide,** $\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2I}{I}$.

Sl. sol. in boiling H_2O. (Cleve.)

—— **nitrate,** $\mathrm{Pt}\genfrac{}{}{0pt}{}{(NH_3)_2NO_3}{NO_3}$.

Moderately sol. in H_2O. (Cleve.)

—— **nitrite,** $\mathrm{Pt}\genfrac{}{}{0pt}{}{(NH_3)_2NO_2}{NO_2}$.

Very sl. sol. in cold, more easily in hot H_2O.

—— **oxalate,** $Pt(NH_3)_2C_2O_4$.

(Cleve.)
+$2H_2O$. (Cleve.)

—— **sulphate,** $\mathrm{Pt}\overset{(NH_3)_2}{\longleftrightarrow}SO_4$.

Very sl. sol. even in hot H_2O. (Cleve.)

—— **sulphocyanide,** $Pt(SCN)(NH_3)_2SCN$.

Easily sol. in warm H_2O, but solution soon decomposes.

Plato*semidi*amine sulphurous acid.

Ammonium plato*semidi*amine sulphite,
$\mathrm{Pt}<\genfrac{}{}{0pt}{}{(NH_3)_2SO_3(NH_4)}{SO_3(NH_4)}, (NH_4)_2SO_3$.

Very sol. in H_2O. (Cleve.)

Barium ——, $Pt(SO_3)[(NH_3)_2SO_3]Ba, BaSO_3$.

Ppt. (Cleve.)

Silver ——, $Pt(SO_3Ag)[(NH_3)_2SO_3Ag], Ag_2SO_3$.

Ppt. (Cleve.)

***Di*plato*di*amine chloride,** $Pt_2(NH_3)_4Cl_2$.

Insol. in H_2O.

—— **hydroxide,** $Pt_2(NH_3)_4(OH)_2 + H_2O$.

Insol. in H_2O.

—— **nitrate,** $Pt_2(NH_3)_4(NO_3)_2$.

Insol. in H_2O. (Cleve.)

—— **sulphate,** $Pt_2(NH_3)_4SO_4$.

Insol. in H_2O. (Cleve.)

Platobromonitrous acid.

Potassium platobromonitrite, $K_2Pt(NO_2)_3Br + 2H_2O$.

Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes, A. ch. (6) **29**. 194.)

$K_2Pt(NO_2)_2Br_2 + H_2O$. Sol. in 1 pt. cold, and still less hot H_2O. Insol. in alcohol. (Vèzes.)

Platochloronitrous acid.

Potassium chloronitrite, $K_2Pt(NO_2)_3Cl + 2H_2O$.

Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes, A. ch. (6) **29**. 178.)

$K_2Pt(NO_2)_2Cl_2$. Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes.)

Platochlorosulphurous acid.

See **Chloroplatosulphurous acid.**

Platoiodonitrous acid, $H_2Pt(NO_2)_2I_2$.

Known only in solution. (Nilson, J. pr. (2) **21**. 172.)

Aluminum platoiodonitrite, $Al_2[Pt(NO_2)_2I_2]_3 + 27H_2O$.

Easily sol. in H_2O. (Nilson.)

Ammonium ——, $(NH_4)_2Pt(NO_2)_2I_2 + 2H_2O$.

Sol. in H_2O; decomp. on heating.

Barium ——, $BaPt(NO_2)_2I_2 + 4H_2O$.

Very sol. in H_2O.

Cadmium ——, $CdPt(NO_2)_2I_2 + 2H_2O$.

Easily sol. in H_2O.

Cæsium ——, $Cs_2Pt(NO_2)_2I_2 + 2H_2O$.

Easily sol. in H_2O.

Calcium ——, $CaPt(NO_2)_2I_2 + 6H_2O$.

Very easily sol. in H_2O.

Cerium ——, $Ce_2[Pt(NO_2)_2I_2]_3 + 18H_2O$.

Easily sol. in H_2O.

Cobalt ——, $CoPt(NO_2)_2I_2 + 8H_2O$.

Sol. in H_2O.

Didymium ——, $Di_2[Pt(NO_2)_2I_2]_3 + 24H_2O$.

Sol. in H_2O.

Erbium platoiodonitrite, $Er_2[Pt(NO_2)_2I_2]_3+18H_2O$.
Sol. in H_2O.

Ferrous ——, $FePt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Ferric ——, $Fe_2[Pt(NO_2)_2I_2]_3+6H_2O$.
Sol. in H_2O.

Lanthanum ——, $La_2[Pt(NO_2)_2I_2]_3+24H_2O$.
Sol. in H_2O.

Lead ——, basic, $PbPt(NO_2)_2I_2, Pb(OH)_2$.
Insol. in H_2O.

Lithium ——, $Li_2Pt(NO_2)_2I_2+6H_2O$.
Very sol. in H_2O.

Magnesium ——, $MgPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Manganese ——, $MnPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Mercurous ——, basic, $2Hg_2Pt(NO_2)_2I_2, Hg_2O+9H_2O$.
Insol. in H_2O.

Nickel ——, $NiPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Potassium ——, $K_2Pt(NO_2)_2I_2+2H_2O$.
Sol. in H_2O.

Rubidium ——, $Rb_2Pt(NO_2)_2I_2+2H_2O$.
Sol. in H_2O.

Silver ——, $Ag_2Pt(NO_2)_2I_2$.
Insol. in H_2O.

Sodium ——, $Na_2Pt(NO_2)_2I_2+4H_2O$.
Very sol. in H_2O.

Strontium ——, $SrPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Thallium ——, $Tl_2Pt(NO_2)_2I_2$.
Insol. in H_2O.

Yttrium ——, $Y_2[Pt(NO_2)_2I_2]_3+27H_2O$.
Sol. in H_2O.

Zinc ——, $ZnPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

***Tri*plato*octo*nitrosylic acid,** $H_4Pt_3O(NO_2)_8$.
(Nilson, J. pr. (2) **16.** 241.)

Potassium *tri*plato*octo*nitrosylate.
See under **Platonitrite, potassium.**

Platonitrous acid, $H_2Pt(NO_2)_4$.
Sol. in H_2O or alcohol. (Lang, J. pr. **83.** 419.)
Is called "Plato*tetra*nitrosylic acid" by Nilson.

Aluminum platonitrite, $Al_2[Pt(NO_2)_4]_3+14H_2O$.
Sol. in H_2O.
$Al_2(OH)_2[Pt(NO_2)_2]_4O_2+10H_2O$. Sl. sol. in cold, easily in hot H_2O and alcohol. (Nilson, B. **9.** 1727.)

Ammonium platonitrite, $(NH_4)_2Pt(NO_2)_4+2H_2O$.
Moderately sol. in cold H_2O. (Nilson, B. **9.** 1724.)

Barium platonitrite, $BaPt(NO_2)_4+3H_2O$.
Sl. sol. in cold, very sol. in hot H_2O. (Lang.)

Cadmium platonitrite, $CdPt(NO_2)_4+3H_2O$.
Easily sol. in H_2O. (Nilson.)

Cæsium platonitrite, $Cs_2Pt(NO_2)_4$.
Resembles K salt.

Calcium platonitrite, $CaPt(NO_2)_4+5H_2O$.
Very sol. in H_2O. (Nilson.)

Cerium platonitrite, $Ce_2[Pt(NO_2)_4]_3+18H_2O$.
Sol. in H_2O. (Nilson.)

Chromium *di*platonitrite, $Cr_2(OH)_2[Pt(NO_2)_2]_4O_2+24H_2O$.
Sol. in H_2O. (Nilson.)

Cobalt platonitrite, $CoPt(NO_2)_4+8H_2O$.
Easily sol. in H_2O. (Nilson.)

Copper platonitrite, $CuPt(NO_2)_4+3H_2O$.
Sol. in H_2O. (Nilson.)
$3CuPt(NO_2)_4, CuO+18H_2O$. Decomp. by H_2O. (Nilson.)

Didymium platonitrite, $Di_2[Pt(NO_2)_4]_3+18H_2O$.
Deliquescent; sol. in H_2O.

Erbium platonitrite, $Er_2[Pt(NO_2)_4]_3+9$, and $21H_2O$.
Deliquescent; sol. in H_2O.

Glucinum *di*platonitrite, $Gl[Pt(NO_2)_2]_2O+9H_2O$.
Sl. sol. in cold H_2O.

Indium *di*platonitrite, $In(OH)_2[Pt(NO_2)_2]_4O_2+10H_2O$.
Sl. sol. in H_2O.

Ferric *di*platonitrite, $Fe_2[Pt(NO_2)_2]_6O_3+30H_2O$.
Sl. sol. in cold, easily in hot H_2O.

Lanthanum platonitrite, $La_2[Pt(NO_2)_4]_3+18H_2O$.
Deliquescent; sol. in H_2O.

Lead platonitrite, $PbPt(NO_2)_4+3H_2O$.
Sl. sol. in H_2O. (Nilson.)

Lithium platonitrite, $Li_2Pt(NO_2)_4+3H_2O$.
Sl. deliquescent; easily sol. in H_2O.

Magnesium platonitrite, $MgPt(NO_2)_4+5H_2O$.
Easily sol. in H_2O.

Manganese platonitrite, $MnPt(NO_2)_4+8H_2O$.
Sol. in H_2O.

Mercurous platonitrite, $Hg_2Pt(NO_2)_4, Hg_2O$.
Nearly insol. in H_2O. (Lang, J. pr. **83.** 415.)
$+H_2O$. Nearly insol. in H_2O. (Nilson.)

Nickel platonitrite, $NiPt(NO_2)_4+8H_2O$.
Easily sol. in H_2O. (Nilson.)

Potassium platonitrite, $K_2Pt(NO_2)_4$.
Sol. in 27 pts. H_2O at 15°; more easily sol. in warm H_2O. (Lang, J. pr. **83.** 415.)
$+2H_2O$. Efflorescent. (Lang.)
$K_2H_4Pt_3O(NO_2)_8+3H_2O$. Very sl. sol. in cold, but very easily in hot H_2O. (Vèzes, A. ch. (6) **29.** 162.)

$K_4Pt_3O(NO_2)_8+2H_2O$. Sl. sol. in warm H_2O. (Nilson.)

Potassium platonitrite bromide.

See **Platibromonitrite** *and* **platobromonitrite, potassium.**

Potassium platonitrite chloride.

See **Plati-** *and* **platochloronitrite, potassium.**

Potassium platonitrite iodide.

See **Plati-** *and* **platoiodonitrite, potassium.**

Rubidium platonitrite, $Rb_2(Pt)(NO_2)_4$, and $+2H_2O$.

Resembles K salt.

Silver platonitrite, $Ag_2Pt(NO_2)_4$.

Very sl. sol. in cold, easily in hot H_2O.

Silver *di*platonitrite, $Ag_2Pt_2(NO_2)_4O$.

Insol. in H_2O. (Nilson.)

Sodium platonitrite, $Na_2Pt(NO_2)_4$.

Easily sol. in H_2O.

Strontium platonitrite, $SrPt(NO_2)_4+3H_2O$.

Somewhat sl. sol. in cold H_2O, but easily sol. in warm H_2O.

Thallium platonitrite, $Tl_2Pt(NO_2)_4$.

Very sl. sol. in H_2O. (Nilson.)

Yttrium platonitrite, $Y_2[Pt(NO_2)_4]_3+9$, or $21H_2O$.

Sol. in H_2O.

Zinc platonitrite, $ZnPt(NO_2)_4+8H_2O$.

Sol. in H_2O.

Plato*di*oxamine chloride, $Pt(NH_3O.NH_3OCl)_2$.

Easily sol. in H_2O. (Alexander, A. **246**. 239.)

—— **chloroplatinite,** $Pt(NH_3O.NH_3OCl)_2, PtCl_2$.

Sol. in warm HCl+Aq. Insol. in cold H_2O or alcohol; very sl. sol. in hot H_2O. (Alexander.)

—— **hydroxide,** $Pt(NH_3O.NH_3O)_2(OH)_2$.

Insol. in H_2O or alcohol. Easily sol. in HCl or HNO_3+Aq. Difficultly sol. in hot dil. H_2SO_4+Aq. (Alexander.)

—— **oxalate,** $Pt(NH_3O.NH_3O)_2C_2O_4$.

Insol. in cold H_2O, alcohol, or organic acids. (Alexander.)

—— **phosphate,** $Pt_3(NH_3O.NH_3O)_{12}(PO_4)_2+3H_2O$.

Ppt. (Alexander.)

—— **sulphate,** $Pt(NH_3O.NH_3O)SO_4+H_2O$.

Sl. sol. in H_2O. (Alexander.)

Platosamine bromide, $Pt(NH_3Br)_2$.

Sl. sol. even in hot H_2O. (Cleve.)

—— **chloride,** $Pt(NH_3Cl)_2$.

"Reiset's second chloride." Sol. in 140 pts. H_2O at 100°. (Peyrone, A. **61**. 180.)

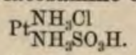
Sol. in 130 pts. H_2O at 100°, and 4472 pts. at 0°. (Cleve.)

Easily sol. in NH_4OH+Aq, HNO_3, or aqua regia, with decomp. Sol. in KCN+Aq with evolution of NH_3. (Cleve.)

—— **ammonium chloride,** $Pt(NH_3Cl)_2, 2NH_4Cl$.

Sl. sol. in cold, easily in hot H_2O; insol. in alcohol; sol. in NH_4OH or $(NH_4)_2CO_3$+Aq. (Grimm, A. **99**. 75.)

Platosamine chlorosulphurous acid,



$Pt\begin{matrix}NH_3Cl\\NH_3SO_3H\end{matrix}$.

Easily sol. in H_2O without decomp. (Cleve.)

Ammonium platosamine chlorosulphite, $Pt(NH_3Cl)NH_3SO_3NH_4+H_2O$.

Sol. in H_2O. (Peyrone, A. **61**. 180.)

Platosamine cyanide, $Pt(NH_3CN)_2$.

Quite easily sol. in H_2O or NH_4OH+Aq. (Buckton.)

—— **hydroxide,** $Pt(NH_3OH)_2$.

"Reiset's second base." Very sol. in H_2O. (Odling, B. **3**. 685.)

—— **iodide,** $Pt(NH_3I)_2$.

Very sl. sol. in H_2O. Sol. in cold NH_4OH+Aq to form platodiamine iodide. (Cleve.)

—— **nitrate,** $Pt(NH_3NO_3)_2$.

Moderately sol. in hot H_2O. Sol. in NH_4OH+Aq with combination. (Reiset, A. ch. (3) **11**. 26.)

—— **nitrite,** $Pt(NH_3NO_2)_2$.

Very sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. (Lang.)

—— **platinous nitrite,** $Pt(NH_3NO_2)_2, Pt(NO_2)_2$.

Slowly and sl. sol. in cold, more easily sol. in hot H_2O.

Extremely sl. sol. even in conc. acids; more sol. in NH_4OH+Aq than in H_2O. (Lang.)

—— **oxide,** $Pt(NH_3)_2O$.

Insol. in H_2O or NH_4OH+Aq. (Reiset.)

—— **oxalate,** $Pt(NH_3)_2H_2(C_2O_4)_2+2H_2O$.

Ppt. (Cleve.)

—— **sulphate,** $Pt(NH_3)_2SO_4+H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

—— **sulphite,** $Pt(NH_3)_2SO_3+H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **sulphocyanide,** $Pt(NH_3SCN)_2$.

Insol. in H_2O; can be cryst. from alcohol; not attacked by HCl or H_2SO_4+Aq. (Buckton.)

Very sol. in hot H_2O. (Cleve.)

—— **silver sulphocyanide,** $Pt(NH_3)_2Ag_4(SCN)_6$. (Cleve.)

Platosamine sulphurous acid, $Pt(NH_3SO_3H)_2$.

Exists only in its salts.

See **Platosamine sulphite.**

Ammonium platosamine sulphite, $Pt(NH_3SO_3NH_4)_2$.

Sol. in H_2O. Insol. in alcohol.

Barium platosamine sulphite, $Pt(NH_3)_2(SO_3)_2Ba+3H_2O$.

Ppt. (Cleve.)

Cobalt ——— ———, $Pt(NH_3)_2(SO_3)_2Co+6H_2O$.

Very sl. sol. in H_2O. Sol. in HCl+Aq.

Copper ——— ———, $Pt(NH_3)_2(SO_3)_2Cu+5H_2O$.

Very sl. sol. in H_2O; sol. in HCl+Aq.

Lead ——— ———, $Pt(NH_3)_2(SO_3)_2Pb+H_2O$.

Ppt.

Manganese ——— ———, $Pt(NH_3)_2(SO_3)_2Mn+4H_2O$.

Ppt. Sl. sol. in H_2O.

Nickel ——— ———, $Pt(NH_3)_2(SO_3)_2Ni+7H_2O$.

Sl. sol. in H_2O.

Sodium ——— ———, $Pt(NH_3SO_3Na)_2+5\frac{1}{2}H_2O$.

Sol. in H_2O. 100 ccm. sat. solution at 20° contains 5·52 g. cryst. salt. (Haberland and Hanekop, A. **245**. 235.)

Silver ——— ———, $Pt(NH_3SO_3Ag)_2+H_2O$.

Ppt.

Uranyl ——— ———, $Pt(NH_3)_2(SO_3)_2UO_2+H_2O$.

Ppt.

Zinc ——— ———, $Pt(NH_3)_2(SO_3)_2Zn+6H_2O$.

Ppt. Very sl. sol. in H_2O. (Cleve.)

Platoso*semi*amine potassium chloride, $Pt^{NH_3Cl}_{Cl}$, $KCl+H_2O$.

Very sol. in H_2O; insol. in alcohol. (Cossa, B. **23**. 2507.)

Platosoxamine chloride, $Pt^{NH_3OCl}_{NH_3OCl}$.

Sol. in H_2O. Much less sol. in H_2O than plato*di*oxamine chloride. (Alexander, A. **246**. 239.)

Platosoxamine amine chloride, $Pt^{NH_3O.NH_3Cl}_{NH_3.NH_3OCl}$.

Easily sol. in H_2O. Insol. in alcohol and conc. HCl+Aq. (Alexander, A. **246**. 239.)

——— chloroplatinite, $Pt^{NH_3O.NH_3Cl}_{NH_3.NH_3OCl}$, $PtCl_2$.

Ppt.

Platosulphurous acid.

Ammonium platosulphite, $(NH_4)_6Pt(SO_3)_4+3H_2O$.

Sol. in H_2O. (Birnbaum, A. **139**. 170.)

$(NH_4)_2Pt(SO_3)_2+H_2O$. Sol. in H_2O. (Liebig, Pogg. **17**. 108.)

Ammonium platosulphite chloride, $(NH_4)_2Pt(SO_3)_2$, $2NH_4Cl$.

Sol. in H_2O. (Birnbaum.)

See also **Chloroplatosulphite, ammonium.**

$PtClSO_3H$, $2NH_4Cl$. Deliquescent; sol. in H_2O. (Birnbaum, A. **152**. 143.)

See also **Chloroplatosulphite, ammonium.**

Potassium platosulphite, $K_6Pt(SO_3)_4+4H_2O$.

Sl. sol. in cold, easily in hot H_2O. Much more sol. than the Na salt. (Birnbaum, A. **139**. 168.)

$+3H_2O$. (Lang, J. pr. **83**. 415.)

$6K_2O$, $2PtO$, $10SO_2$. Sl. sol. in H_2O. (Claus, J. B. **1847-48**. 453.)

Does not exist. (Lang.)

$K_2Pt(SO_3)_2$. Sol. in H_2O.

Silver platosulphite, $Ag_6Pt(SO_3)_4$.

Ppt. Very sol. in cold NH_4OH+Aq. (Lang, J. pr. **83**. 415.)

Sodium platosulphite, $Na_6Pt(SO_3)_4$.

Very sl. sol. in cold, somewhat more easily in hot H_2O. Not decomp. by boiling KOH or NaOH+Aq. Gradually sol. in $(NH_4)_2S$ or K_2S+Aq. Insol. in NaCl+Aq or alcohol. (Litton and Schnedermann, A. **42**. 316.)

$+1\frac{1}{2}H_2O$.

$+7H_2O$.

$Na_2Pt(SO_3H)_4$. Moderately sol. in H_2O. (Litton and Schnedermann.)

Platothiosulphuric acid.

Sodium platothiosulphate, $Na_6Pt(S_2O_3)_4+10H_2O$.

Very sol. in H_2O. (Schottländer, A. **140**. 200.)

PtS_2O_3, $4Na_2S_2O_3+10H_2O$.

PtS_2O_3, $6Na_2S_2O_3+19H_2O$.

$2Pt_2S_2O_3$, $7Na_2S_2O_3+18H_2O$. (Jochum, C. C. **1885**. 642.)

Plumbic acid.

Barium plumbate, Ba_2PbO_4.

Insol. in H_2O. Sol. in HCl+Aq with evolution of Cl. Sol. in acids in presence of a reducing substance. (Kassner, Arch. Pharm. **228**. 109.)

Calcium plumbate.

Insol. in H_2O. HNO_3+Aq dissolves out CaO. (Crum, A. **55**. 218.)

Ca_2PbO_4. Properties as Ba_2PbO_4. (Kassner, Arch. Pharm. **228**. 109.)

Potassium plumbate, $K_2PbO_3+3H_2O$.

Very deliquescent. Decomp. by pure H_2O into PbO_2 and KOH. Sol. in KOH+Aq without decomp. (Fremy, J. Pharm. (3) **3**. 32.)

Sodium plumbate.

Sol. in H_2O with decomposition. Sl. sol. in alkalies+Aq. (Fremy, A. ch. (3) **12**. 490.)

Strontium plumbate, Sr_2PbO_4.

Properties as Ba_2PbO_4. (Kassner, Arch. Pharm. **228**. 109.)

Plumbous acid.

Calcium plumbite.

Sl. sol. in H_2O. (Karsten, Scher. J. **5**. 575.

Potassium plumbite, PbO, xK_2O.

Known only in solution.

Silver plumbite, $Ag_2PbO_2+2H_2O$.

Insol. in H_2O. Decomp. on air. (Kratwig, B. **15**. 264.)

Sodium plumbite.

Known only in solution.

Potassium, K_2.

Violently decomposes H_2O or alcohol. Insol. in hydrocarbons. Sol. with violent action in acids. Sol. in liquid NH_3. (Seely, C. N. **23.** 169.)

Potassium amide, KH_2N.

Decomp. by water or alcohol. Insol. in hydrocarbons.

Potassium bromide, KBr.

Solubility of KBr in 100 pts. H_2O at t°.

t°	Pts. KBr	t°	Pts. KBr
0	53·48	60	85·35
20	64·52	80	93·46
40	74·63	100	102·0

(Kremers, Pogg. **97.** 151.)

Solubility of KBr in 100 pts. H_2O at t°.

t°	Pts. KBr	t°	Pts. KBr
−13·4	46·17	43·15	77·0
−6·2	49·57	45·45	77·73
0	53·32	50·5	80·33
+3·4	55·60	54·8	82·78
5·2	56·63	60·15	85·37
12·65	61·03	66·75	88·22
13·0	61·17	71·45	90·69
13·3	61·45	74·85	92·25
18·3	64·11	86·5	97·28
26·05	68·31	97·9	102·9
30·0	70·35	110·0	110·3
37·9	74·46	...	...

Solubility is represented by a straight line of the formula 54·43+0·5128t. (Coppet, A. ch. (5) **30.** 416.)

If solubility S=pts. KBr in 100 pts. solution, S=34·5+0·2420t from 0° to 40°, S=41·5+0·1378t from 30° to 120°. (Étard, C. R. **98.** 1432.)

Solubility of KBr in 100 pts. H_2O at high temp.

t°	Pts. KBr
140	120·9
181	145·6

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Sat. solution boils at 112°. (Kremers.)

Sp. gr. of KBr+Aq at 19°.

% KBr	Sp. gr.	% KBr	Sp. gr.
5	1·037	30	1·256
10	1·075	35	1·309
15	1·116	40	1·366
20	1·159	45	1·432
25	1·207	...	...

(Gerlach, Z. anal. **8.** 285.)

Sp. gr. of KBr+Aq at 15° containing:

5	10	20	30	36 % KBr.
1·0357	1·074	1·1583	1·2553	1·3198

(Kohlrausch, W. Ann. **1879.** 1.)

100 pts. KBr+Aq sat. at 15-16° contain 39·06 pts. KBr. (v. Hauer, J. pr. **98.** 137.)

100 pts. KBr+KCl+Aq sat. at 15-16° contain 37·55 pts. of the two salts; 100 pts. KBr+KI+Aq sat. at 15-16° contain 57·96 pts. of the two salts; 100 pts. KBr+KCl+KI+Aq sat. at 15-16° contain 57·88 pts. of the three salts. (v. Hauer, *l.c.*)

By repeatedly heating KBr+Aq sat. at 15-16° with KI and cooling to 15°, nearly all the KBr can be separated. (v. Hauer.)

100 pts. H_2O sat. with KBr at 16° dissolve 13·15 pts KI, but on addition of more KI, KBr is pptd. (van Melckebeke, C. C. **1872.** 586.)

Sl. sol. in alcohol. (Ballard.)

Sol. in 200 pts. cold, and 16 pts. boiling 80 % alcohol.

Sol. in 180 pts 90 % alcohol. (Hager.)

Sol. in 750 pts. abs. alcohol at 15°. (Eder, Dingl. **221.** 89.)

Sol. in 5000 pts. ether (sp. gr. 0·729) at 15°. (Eder, *l.c.*)

Sol. in 1700 pts. alcohol-ether (1 : 1) at 15°. (Eder, *l.c.*)

100 pts. absolute methyl alcohol dissolve 1·51 pts. at 25°; 100 pts. absolute ethyl alcohol dissolve 0·13 pt. at 25°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. acetone dissolve 0·023 pt. KBr at 25°. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Potassium selenium bromide.

See **Bromoselenate, potassium.**

Potassium tellurium bromide.

See **Bromotellurate, potassium.**

Potassium thallic bromide, KBr, $TlBr_3+2H_2O$.

Sol. in H_2O.

3KBr, $2TlBr_3+3H_2O$. Sol. in H_2O. (Rammelsberg.)

Potassium thorium bromide.

Sol. in H_2O. (Berzelius.)

Potassium stannous bromide, KBr, $SnBr_2+H_2O$.

Sol. in H_2O. (Benas, C. C. **1884.** 958.)

Can be recryst. from HBr or KBr+Aq. (Richardson, Am. Ch. J. **14.** 95.)

2KBr, $SnBr_2+2H_2O$. Cannot be recryst. from HBr+Aq. (Richardson.)

Potassium stannic bromide, 2KBr, $SnBr_4$.

See **Bromostannate, potassium.**

Potassium uranyl bromide, 2KBr, $UO_2Br_2+2H_2O$.

Very easily sol. in H_2O. (Sendtner.)

Potassium bromoiodide, KBr_2I.

Decomp. rapidly on air. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

Potassium carbonyl, $K_2C_2O_2$.

Decomp. by H_2O with explosion. (Joannis, C. R. **116.** 158.)

Potassium chloride, KCl.

Sol. in H_2O with absorption of heat.

30 pts. KCl+100 pts. H_2O at 13·2° lower the temp. 12·6°. (Rüdorff, B. **2.** 68.)

100 pts. H_2O dissolve 29·31 pts. KCl at 0° (Gay-Lussac); 28·5 pts. KCl at 0° (Mulder; Gerardin).

The saturated solution contains 58·5 %, and boils at 107·6° (Mulder); contains 59·40 %, and boils at 108·3° (Legrand); contains 59·26 %, and boils at 109·6° (Gay-Lussac); boils at 110° (Kremers).

Sol. in 3·016 pts. H_2O at 15° (Gerlach); in 3·03 pts. at 17·5°, or 100 pts. H_2O at 17·5° dissolve 33 pts. KCl (Schiff).

100 pts. H_2O at t° dissolve pts. KCl:

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
0	29·21	52·39	43·59	109·60	59·26
19·35	34·53	79·58	50·93	..	..

(Gay-Lussac, A. ch. (2) **11.** 308.)

100 pts. H_2O dissolve 34·6 pts. KCl at 11·8°; 34·9 pts. at 13·8°; 35 pts. at 15·6°. (Kopp.)

100 pts. H_2O at 17·5° dissolve 33·24 pts. KCl, and sp. gr. of solution is 1·1635. (Karsten.)

100 pts. H_2O at 12° dissolve 32 pts., and at 100°, 59·4 pts. (Otto-Graham.)

Sol. in 3 pts. H_2O at ord. temp., and 3 pts. boiling H_2O (Bergmann); in 3·33 pts. hot or cold H_2O (Fourcroy); in 3,pts. at 15°, and 1·68 pts. at 110° (M. R. and P.)

Sol. in 3·5 pts. H_2O at 0°, and in less than 1 pt. hot H_2O (Schubarth); 100 pts. H_2O at 17·5° dissolve 30·7-33·0 pts. KCl (Ure's Dict.).

100 pts. H_2O dissolve 35·405 pts. KCl at 15°, and solution has sp. gr.=1·1809. (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve at:

18°	30°	40°	57°	
33·6	37·8	40·1	45·0	pts. KCl.

(Gerardin, A. ch. (4) **5.** 139.)

100 pts. H_2O dissolve 33·06-32·08 pts. KCl at 15·6° and sp. gr. of solution=1·171. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
0	28·5	17	33·9	34	38·5
1	28·7	18	34·2	35	38·7
2	29·0	19	34·4	36	39·0
3	29·3	20	34·7	37	39·3
4	29·5	21	35·0	38	39·6
5	30·0	22	35·3	39	39·9
6	30·5	23	35·5	40	40·1
7	31·0	24	35·8	41	40·3
8	31·5	25	36·1	42	40·6
9	31·7	26	36·4	43	40·9
10	32·0	27	36·6	44	41·2
11	32·3	28	36·9	45	41·5
12	32·5	29	37·2	46	41·7
13	32·8	30	37·4	47	42·0
14	33·1	31	37·7	48	42·3
15	33·4	32	38·0	49	42·5
16	33·6	33	38·2	50	42·8

Solubility in 100 pts., etc.—*Continued.*

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
51	43·1	71	48·5	91	54·1
52	43·4	72	48·8	92	54·4
53	43·6	73	49·1	93	54·6
54	43·9	74	49·4	94	54·9
55	44·2	75	49·6	95	55·2
56	44·4	76	49·9	96	55·5
57	44·7	77	50·2	97	55·7
58	44·9	78	50·5	98	56·0
59	45·2	79	50·8	99	56·3
60	45·5	80	51·0	100	56·6
61	45·8	81	51·3	101	56·9
62	46·1	82	51·5	102	57·2
63	46·3	83	51·8	103	57·4
64	46·6	84	52·1	104	57·7
65	46·9	85	52·4	105	58·0
66	47·2	86	52·6	106	58·2
67	47·5	87	52·9	107	58·5
68	47·7	88	53·2	107·65	58·5
69	48·0	89	53·5	...	...
70	48·3	90	53·8	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 41.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
-11°	24·46	25·7	36·10	64·95	47·17
-6·4	25·78	29·25	37·31	71·65	48·76
0	27·9	38·0	39·71	74·25	49·27
+3·9	29·37	41·45	40·67	80·75	51·24
9·4	30·84	46·15	42·34	86·6	52·53
11·4	32·19	48·8	42·86	91·4	53·49
14·95	32·66	55·1	44·51	...	...
19·0	34·32	60·55	45·90	...	...

(Coppet, A. ch. (5) **30.** 414.)

Solubility is represented by a straight line, of which the formula is 28·51+0·2837t. (Coppet.)

100 pts. H_2O dissolve 29·33 pts. KCl at 4°, 45·5 pts. at 60°. (Andreae, J. pr. (2) **29.** 456.)

100 pts. H_2O dissolve at:

0°	100°	130°	180°	
29·2	56·5	66	78	pts. KCl.

(Tilden and Shenstone, Lond. R. Soc. Proc. **35.** 345.)

Solubility of KCl in 100 pts. H_2O at high temp.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
125	59·6	147	70·8	180	77·5
133	69·3	175	75·2	...	...

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

If solubility S=pts. KCl in 100 pts. solution, S=20·5+0·1445t from -90° to 110°. (Étard, C. R. **98.** 1432.)

KCl+Aq sat. at 16° has sp. gr.=1·077. (Stolba, J. pr. **97.** 503.)

Sp. gr. of KCl+Aq at 17·5°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1·0062	9	1·0586	17	1·1152
2	1·0125	10	1·0655	18	1·1225
3	1·0189	11	1·0725	19	1·1298
4	1·0254	12	1·0795	20	1·1372
5	1·0319	13	1·0866	21	1·1446
6	1·0385	14	1·0937	22	1·1521
7	1·0451	15	1·1008	23	1·1596
8	1·0518	16	1·1080	24	1·1673

(Schiff, A. **110.** 76.)

Sp. gr. of KCl+Aq at 19·5°.

% KCl	Sp. gr.	% KCl	Sp. gr.
5·98	1·0382	21·31	1·1436
11·27	1·0733	25·133	1·1720
16·27	1·1075	...	...

(Kremers, Pogg. **95.** 119.)

Sp. gr. of KCl+Aq at 15°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1·00650	10	1·06580	19	1·12894
2	1·01300	11	1·07271	20	1·13608
3	1·01950	12	1·07962	21	1·14348
4	1·02600	13	1·08654	22	1·15088
5	1·03250	14	1·09345	23	1·15828
6	1·03916	15	1·10036	24	1·16568
7	1·04582	16	1·10750	24·9*	1·17234
8	1·05248	17	1·11465	...	...
9	1·05914	18	1·12179	...	...

* Mother liquor.

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. of KCl+Aq at 20°, containing mols. KCl to 100 mols. H_2O.

Mols. KCl	Sp. gr.	Mols. KCl	Sp. gr.
0·5	1·01310	4·0	1·09415
1·0	1·02568	5·0	1·11445
2·0	1·04959	...	...

(Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of KCl+Aq at 18°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
5	1·0308	15	1·0978	25	1·1408
10	1·0638	20	1·1335	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of KCl+Aq at 0°. S=pts. salt in 100 pts. of solution; S_1=mols. salt in 100 mols. solution.

S	S_1	Sp. gr.
20·7840	5·954	1·1489
17·7214	4·940	1·1258
14·4707	3·922	1·1018
11·0757	2·918	1·0769
7·5440	1·931	1·0521
4·4968	1·123	1·0308

(Charpy, A. ch. (6) **29.** 23.)

KCl+Aq containing 10 % KCl boils at 101·1°; containing 20 %, at 103·4°. (Gerlach.)

Sat. KCl+Aq containing 52·7 pts. KCl to 100 pts. H_2O forms a crust at 107·7°; highest temp. observed, 108·5°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of KCl+Aq containing pts. KCl to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 438); L=according to Legrand (A. ch. (2) **59.** 426).

B.-pt.	G	L	B.-pt.	G	L
100·5°	4·9	4·7	105°	36·2	37·8
101·0	9·2	9·0	105·5	39·3	41·0
101·5	13·1	13·2	106	42·4	44·2
102	16·7	17·1	106·5	45·5	47·4
102·5	20·1	20·9	107	48·4	50·5
103	23·4	24·5	107·5	51·5	53·7
103·5	26·7	28·0	108	54·5	56·9
104	29·9	31·4	108·3	...	59·4
104·5	33·1	34·6	108·5	57·4	...

Precipitated from aqueous solution by HCl+Aq. Much less sol. in very dil. HCl+Aq than in H_2O. (Fresenius.)

Nearly insol. in conc. HCl+Aq.

Solubility in KOH+Aq. KCl=mols. KCl (in mgs.) in 10 ccm. of solution at 0°; K_2O= mols. K_2O (in mgs.) in 10 ccm. of solution at 0°.

KCl	K_2O	KCl+K_2O	Sp. gr.
34·5	0	34·5	1·159
31	2·375	33·375	1·146
28·3	4·7	33	1·153
23	9·9	32·9	1·172
18·375	15·06	33·435	1·195
14·425	20	34·425	1·216
11·425	24·625	36·050	1·239
8·975	29·25	38·225	1·261
6·275	35·125	41·400	1·294

(Engel, Bull. Soc. (3) **6.** 16.)

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl.

When action has ceased, the solution at 18·75° contains 31·6 % of the mixed salt; or 100 pts. H_2O dissolve 46·1 pts. of the mixed salt, viz. 16·27 pts. KCl and 29·83 pts. NH_4Cl. (Karsten.) (See NH_4Cl.)

Sol. in sat. $BaCl_2$+Aq with pptn. of $BaCl_2$ until a state of equilibrium is reached, when 100 pts. H_2O at 16·8° dissolve 45·9 pts. mixed salts, viz. 18·2 pts. $BaCl_2$ and 27·7 pts. KCl. (See $BaCl_2$.)

Sol. in sat. KNO_3+Aq with pptn. of KNO_3. (See KNO_3.)

Sol. in sat. $NaNO_3$+Aq without causing pptn. (See $NaNO_3$.)

Sol. in sat. $Ba(NO_3)_2$+Aq without causing pptn.

100 pts. H_2O dissolve 133·2 pts. KI and 10·4 pts. KCl at 21·5°, no matter how prepared. (Rüdorff, B. **6**. 484.)

100 pts. KCl+Aq sat. at 15-16° contain 25·26-25·37 pts. KCl. 100 pts. KCl+KI+Aq sat. at 15-16° contain 57·80 pts. of the two salts. KCl is pptd. by KI. (v. Hauer, J. pr. **98**. 137.)

Solubility of KCl in $MgCl_2$+Aq of given percentage composition.

t°	30 %	21·2 %	15 %	11 %
10	1·9 %	5·3 %	9·9 %	14·3 %
20	2·6	6·5	11·3	15·9
30	3·4	7·6	12·7	17·5
40	4·2	8·8	14·2	19·0
50	5·0	10·0	15·6	20·5
60	5·8	11·2	17·0	21·9
70	6·5	12·4	18·3	23·2
80	7·3	13·6	19·5	24·5
90	8·1	14·7	20·8	25·8
100	8·9	15·9	22·1	27·1

(Precht and Wittgen.)

Solubility of KCl+NaCl in 20 % $MgCl_2$+Aq.

t°	% KCl	% NaCl	t°	% KCl	% NaCl
10	4·2	5·7	60	8·9	6·3
20	5·1	5·8	70	9·9	6·4
30	6·0	5·9	80	10·9	6·6
40	6·9	6·0	90	11·9	6·7
50	7·9	6·1	100	13·0	6·9

(P. and W.)

KCl+NaCl.

100 pts. KCl+NaCl+Aq sat. at 13-16° contain 30·18 pts. of the two salts. (v. Hauer.)

100 pts. H_2O dissolve 13·92 pts. KCl and 30·65 pts. NaCl at 15·6°, and solution has sp. gr.=1·233. (Page and Keightley.)

100 pts. H_2O dissolve 10·11 pts. KCl, 32·15 pts. NaCl, and 4·69 pts. K_2SO_4, and solution has sp. gr.=1·250. (P. and K.)

100 pts. H_2O dissolve 29·9 pts. NaCl and 15·7 pts. KCl at 18·8°. (Rüdorff.)

Solubility of KCl+NaCl in H_2O at t°. 100 pts. H_2O dissolve pts. KCl and pts. NaCl.

t°	Pts. KCl	Pts. NaCl	t°	Pts. KCl	Pts. NaCl
10	12·5	29·7	60	24·6	27·2
20	14·7	29·2	70	27·3	26·8
30	17·2	28·7	80	30·0	26·4
40	19·5	28·2	90	32·9	26·1
50	22·0	27·7	100	34·7	25·8

(Precht and Wittgen, B. **14**. 1667.)

100 pts. H_2O dissolve 13·99 pts. KCl+30·54 pts. NaCl=44·53 pts. mixed salts at 20°. (Nicol, Phil. Mag. (5) **31**. 385.)

KCl+$SrCl_2$.

100 pts. H_2O dissolve 11·2 pts. KCl and 48·6 pts. $SrCl_2$ at 14·5°. (v. Hauer.)

If $SrCl_2$+Aq sat. at 14·5° is sat. with KCl at same temp., 100 pts. H_2O dissolve:

KCl . . .	33·2	11·2	...
$SrCl_2$ . .	...	48·6	50·7
		59·8	

(Mulder, Scheik. Verhandel. **1864**.)

KCl+$(NH_4)_2SO_4$.

Sat. solution of KCl+$(NH_4)_2SO_4$ at b.-pt. when cooled to 14° has different composition from sat. solution of $(NH_4)Cl$ and K_2SO_4, and its composition is changed by warming it with either KCl or $(NH_4)_2SO_4$. (Rüdorff.)

KCl+K_2SO_4.

100 pts. H_2O contain the following amounts salt at 18·75°: (1) sat. with KCl alone; (2) sat. first with KCl then with K_2SO_4; (3) sat. with K_2SO_4 and KCl together; (4) sat. first with K_2SO_4 then with KCl; (5) sat. with K_2SO_4 alone.

	1	2	3	4	5
KCl .	34·5	32·96	33·12	33·12	...
K_2SO_4 .	...	1·79	1·75	1·83	10·8

(Karsten.)

100 pts. H_2O sat. with both K_2SO_4 and KCl contain the following amounts.

	At 14·8°		
KCl . .	33·5	28·2	...
K_2SO_4 .	...	2·0	10·3
	At 15·8°		
KCl . .	33·6	27·9	...
K_2SO_4 .	...	2·3	10·4
	At 16·1°		
KCl . .	33·6	27·1	...
K_2SO_4 .	...	3·3	10·4

(Kopp, A. **34**. 264.)

Sat. K_2SO_4+Aq dissolves KCl only with pptn. of K_2SO_4, but sat. KCl+Aq dissolves some K_2SO_4 without any separation. (Karsten.)

Solubility of KCl+K_2SO_4. 100 pts. H_2O dissolve at t°:

t°	Pts. KCl	Pts. K_2SO_4	t°	Pts. KCl	Pts. K_2SO_4
10	30·9	1·32	60	43·8	1·94
20	33·4	1·43	70	46·5	2·06
30	36·1	1·57	80	49·2	2·21
40	38·7	1·68	90	52·0	2·38
50	41·3	1·82	100	54·5	2·53

(Precht and Wittgen.)

Sol. in 20 % $KC_2H_3O_2$+Aq. (Stromeyer.)

100 pts. alcohol of 0·900 sp. gr. dissolve 4·62 pts.; 0·872, 1·66 pts.; 0·834, 0·38 pt.; 0·817, 0·00 pt. KCl. (Kirwan.)

Sol. in 48 pts. boiling alcohol. (Wenzel.)

Insol. in absolute alcohol containing LiCl. (Mitscherlich.)

At 15°, 100 pts. alcohol of p percentage by volume (S=sp. gr.) dissolve pts. KCl as follows:

p	10	20	30	40	50	60	80
S	0·984	0·972	0·958	0·940	0·918	0·896	0·848
KCl	19·8	14·7	10·7	7·7	5·0	2·8	0·45

(Schiff, A. **118**. 365.)

100 pts. of a mixture of 40 % alcohol with 60 % H_2O dissolve 9·2 pts. KCl at 15°. (Schiff.)

Insol. in absolute alcohol or in 96 % alcohol at 15° or below. At 20°, 100 pts. of the latter dissolve 0·04 pt.; at 25°, 0·06 pt.; at 30°, 0·20 pt. KCl. Dilute alcohol dissolves less KCl than the contained H_2O would dissolve by itself.

Solubility in dil. alcohol. D=sp. gr. of alcohol; S=solubility in 100 pts. alcohol at t°.

D=0·9904		D=0·9848		D=0·9793		D=0·9726	
t°	S	t°	S	t°	S	t°	S
0	23·2	4	20·9	4	16·4	3	12·2
4	24·8	20	25·5	21	20·3	5	12·7
22	29·4	27	26·6	28	22·0	16	15·4
25	30·2	30	27·5	43	25·6	20	16·1
34	32·8	37	29·0	...	...	25	17·3
52	37·5	60	35·2	...	...	34	19·0
D=0·9573		D=0·9390		D=0·8967		D=0·8244	
t°	S	t°	S	t°	S	t°	S
10	8·8	2	4·2	12	2·87	4	0·00
11	9·0	7	5·1	31	4·35	15	0·00
17	10·3	16	6·4	47	4·88	20	0·04
30	12·5	30	8·5	65	5·65	25	0·06
40	13·9	38	9·6	...	...	32	0·20
60	16·7	57	11·3	...	...	...	...

(Gerardin, A. ch. (4) **5**. 140.

Solubility of KCl in dil. alcohol at 14·5°.

Sp. gr.	100 ccm. containing		
	Alcohol	Water	KCl
1·1720	...	88·10	29·10
1·1542	2·79	85·78	26·85
1·1365	4·98	84·00	24·67
1·1075	10·56	79·63	20·56
1·1085	15·57	75·24	17·24
1·0545	20·66	70·52	14·27
1·0455	24·25	67·05	13·25
0·9695	40·42	50·18	6·35
0·9315	48·73	40·60	3·82
0·8448	68·63	15·55	0·30

(Bodländer, Z. phys. Ch. **7**. 316.)

100 pts. absolute methyl alcohol dissolve 0·5 pt. at 18·5°; 100 pts. absolute ethyl alcohol dissolve 0·034 pt. at 18·5°. (de Bruyn, Z. phys. Ch. **10**. 783.)

100 pts. 40 % wood alcohol dissolve 9·2 pts. KCl. (Schiff.)

Very sl. sol. in mixture of equal pts. absolute alcohol and ether. (Berzelius.)

500 mg. KCl treated with 10 g. of above mixture yield only 0·3 mg. to the liquid. (Lawrence Smith, Am. J. Sci. **16**. 56.)

Sol. in glycerine. (Pelouze.)

Insol. in CS_2. (Baeyer.)

Insol. in fusel-oil. (Gooch, Am. Ch. J. **9**. 53.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6**. 184.)

Potassium rhodium chloride, 6KCl, Rh_2Cl_6+$6H_2O$.

See **Chlororhodite, potassium.**

Potassium ruthenium *sesqui*chloride.

See **Chlororuthenite, potassium.**

Potassium ruthenium *tetra*chloride.

See **Chlororuthenate, potassium.**

Potassium tellurium chloride.

See **Chlorotellurate, potassium.**

Potassium thallic chloride, 3KCl, $TlCl_3$+$2H_2O$.

Sol. in H_2O. Not decomp. by boiling H_2O. (Rammelsberg.)

Potassium thorium chloride, KCl, $2ThCl_4$+$18H_2O$.

Deliquescent: sol. in H_2O and alcohol. (Berzelius.)

Potassium stannous chloride (Potassium chlorostannite), KCl, $SnCl_2$+H_2O.

Decomp. by H_2O; sol. in hot HCl or KCl+Aq. (Remsen and Richardson, Am. Ch. J. **14**. 90.)

2KCl, $SnCl_2$+H_2O. Partially decomp. by dissolving in H_2O. (Rammelsberg, Pogg. **94**. 507.)

+$2H_2O$. Very sol. in hot, and but slightly in cold HCl+Aq or KCl+Aq. (Remsen and Richardson.)

$4KCl, SnCl_2+3H_2O$. (Poggiale, C. R. **20.** 1182.)
Does not exist. (Remsen and Richardson.)

Potassium stannic chloride, $2KCl, SnCl_4$.
See **Chlorostannate, potassium.**

Potassium uranyl chloride, $2KCl, UO_2Cl_2+2H_2O$.
Very sol. in H_2O and alcohol. (Arfvedson.)
Sol. in H_2O, with decomp. and separation of KCl, unless H_2O is acidulated with HCl. (Peligot, A. ch. (3) **5.** 37.)

Potassium yttrium chloride.
Sol. in H_2O with evolution of heat.

Potassium zinc chloride, $2KCl, ZnCl_2$.
Very deliquescent. Sol. in 1 pt. cold, and in all proportions of hot H_2O. (Pierre, A. ch. (3) **16.** 248.)

Potassium chloroiodide, KCl_2I.
Very unstable. (Wells and Wheeler, Sill. Am. J. **143.** 475.)
KCl_4I. Sol. in H_2O with decomp. Ether dissolves out ICl_3. (Filhol, J. Pharm. **25.** 433.)

Potassium fluoride, KF or K_2F_2.
Very deliquescent. Very sol. in H_2O. Sl. sol. in HF+Aq. Easily sol. in conc. $KC_2H_3O_2$+Aq. Insol. in alcohol. (Berzelius.) Sol. in dilute alcohol. (Stromeyer, A. **100.** 83.)
Sp. gr. of aqueous solution of KF at 18° containing—

5	10	20	30	40	% KF.
1·041	1·084	1·117	1·272	1·378	

(Kohlrausch, W. Ann. **1879.** 1.)

$+2H_2O$. Very deliquescent. (Guntz, A. ch. (6) **3.** 20.)

Potassium hydrogen fluoride, $KF, HF=KHF_2$.
Easily sol. in H_2O. Sl. sol. in H_2O containing HF. Easily sol. in conc. $KC_2H_3O_2$+Aq. Sol. in dil. alcohol, but insol. in absolute alcohol.
KF, 2HF. Deliquescent. Decomp. by H_2O with absorption of heat. (Moissan, C. R. **106.** 547.)
KF, 3HF. As above. (Moissan.)

Potassium tantalum fluoride.
See **Fluotantalate, potassium.**

Potassium tellurium fluoride, KF, TeF_4.
Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Potassium thorium fluoride, $2KF, ThF_4+4H_2O$.
Nearly insol. in H_2O. Sol. in HF+Aq.
KF, ThF_4. Precipitate. (Chydenius.)

Potassium stannous fluoride, $2KF, 3SnF_2+H_2O$.
Sol. in H_2O. (Wagner, B. **19.** 896.)

Potassium stannic fluoride.
See **Fluostannate, potassium.**

Potassium titanium ***tetra*****fluoride.**
See **Fluotitanate, potassium.**

Potassium titanium ***sesqui*****fluoride,** $4KF, Ti_2F_6$.
Precipitate. Very sl. sol. in H_2O. Sol. in dil. acids. (Piccini, C. R. **97.** 1064.)
See also **Fluo*sesqui*titanate, potassium.**

Potassium titanyl fluoride.
See **Fluoxypertitanate, potassium.**

Potassium tungstyl fluoride.
See **Fluoxytungstate, potassium.**

Potassium uranium fluoride, KF, UF_4.
Insol. in H_2O and dil. acids. Difficultly sol. in conc. HCl+Aq. Sol. in conc. H_2SO_4. (Bolton, J. B. **1866.** 212.)

Potassium uranyl fluoride.
See **Fluoxyuranate, potassium.**

Potassium vanadium ***sesqui*****fluoride.**
See **Fluovanadate, potassium.**

Potassium vanadium ***tetra*****fluoride** (?).
Easily sol. in H_2O. Insol. in alcohol. (Berzelius.)

Potassium zinc fluoride, KF, ZnF_2.
Sol. in H_2O. (R. Wagner.)
$2KF, ZnF_2$. Sol. in H_2O. (Berzelius.)

Potassium zirconium fluoride.
See **Fluozirconate, potassium.**

Potassium fluoride vanadic acid.
See **Fluoxyvanadate, potassium.**

Potassium hydrogenide, K_2H_4.
Ignites on air.

Potassium hydrosulphide, KSH.
Very deliquescent, and sol. in H_2O with gradual decomp. Crystallises with $\frac{1}{2}H_2O$. Sol. in alcohol.

Potassium hydroxide, KOH.
Very deliquescent, and sol. in H_2O with evolution of much heat. 100 pts. KOH, exposed over H_2O at 16-20°, take up 460 pts. H_2O in 56 days. (Mulder.)

1 pt. KOH dissolves in 0·5 pt. cold H_2O (Lowitz); in 0·47 pt. cold H_2O (Bineau, C. R. 41. 509); in 1 pt. H_2O (Abl)

Sp. gr. and b.-pt. of KOH+Aq according to Dalton.

% K_2O	Sp. gr.	B.-pt.	% K_2O	Sp. gr.	B.-pt.
4·7	1·06	100·56°	36·8	1·44	123·89°
9·5	1·11	101·11	39·6	1·47	129·44
13·0	1·15	101·66	42·9	1·52	135·56
16·2	1·19	103·33	46·7	1·60	143·33
19·5	1·23	104·44	51·2	1·68	160·00
23·4	1·28	106·66	56·8	1·78	188·22
26·3	1·33	109·44	63·6	1·88	215·56
29·4	1·36	112·22	72·4	2·00	315·56
32·4	1·39	115·56	84·0	2·2	red heat
34·4	1·42	118·89	100	2·4	..

Sp. gr. of KOH+Aq at 15°.

% K_2O	Sp. gr.	% K_2O	Sp. gr.	% K_2O	Sp. gr.
0·568	1·0050	10·750	1·1059	20·935	1·2268
1·697	1·0153	11·882	1·1182	21·500	1·2342
2·829	1·0560	13·013	1·1308	22·632	1·2493
3·961	1·0369	14·145	1·1437	23·764	1·2648
5·002	1·0478	15·277	1·1568	24·895	1·2805
6·224	1·0589	16·408	1·1702	26·027	1·2966
7·355	1·0703	17·540	1·1839	27·158	1·3131
8·487	1·0819	18·671	1·1979	28·290	1·3300
9·619	1·0938	19·803	1·2122	..	..

(Zimmermann, N. J. Pharm. **18**, **2**. 5.)

Sp. gr. of KOH+Aq.

% K_2O	Sp. gr.	% K_2O	Sp. gr.	% K_2O	Sp. gr.
2·44	1·02	23·14	1·22	37·97	1·42
4·77	1·04	24·77	1·24	40·17	1·44
7·02	1·06	26·34	1·26	42·31	1·46
9·20	1·08	27·86	1·28	44·40	1·48
11·28	1·10	29·34	1·30	46·45	1·50
13·30	1·12	30·74	1·32	48·46	1·52
15·38	1·14	32·14	1·34	50·09	1·54
17·40	1·16	33·46	1·36	51·58	1·56
19·34	1·18	34·74	1·38	53·06	1·58
21·25	1·20	35·99	1·40	..	..

(Richter.)

Sp. gr. of KOH+Aq at 15°. a=sp. gr. if % is K_2O; b=sp. gr. if % is KOH.

%	a	b	%	a	b
1	1·010	1·009	31	1·370	1·300
2	1·020	1·017	32	1·385	1·311
3	1·030	1·025	33	1·403	1·324
4	1·039	1·033	34	1·418	1·336
5	1·048	1·041	35	1·431	1·349
6	1·058	1·049	36	1·445	1·361
7	1·068	1·058	37	1·460	1·374
8	1·078	1·065	38	1·475	1·387
9	1·089	1·074	39	1·490	1·400
10	1·099	1·083	40	1·504	1·411
11	1·110	1·092	41	1·522	1·425
12	1·121	1·110	42	1·539	1·438
13	1·132	1·111	43	1·564	1·450
14	1·143	1·119	44	1·570	1·462
15	1·154	1·128	45	1·584	1·472
16	1·166	1·137	46	1·600	1·488
17	1·178	1·146	47	1·615	1·499
18	1·190	1·155	48	1·630	1·511
19	1·202	1·166	49	1·645	1·527
20	1·215	1·177	50	1·660	1·539
21	1·230	1·188	51	1·676	1·552
22	1·242	1·198	52	1·690	1·565
23	1·256	1·209	53	1·705	1·578
24	1·270	1·220	54	1·720	1·590
25	1·285	1·230	55	1·733	1·604
26	1·300	1·241	56	1·746	1·618
27	1·312	1·252	57	1·762	1·630
28	1·326	1·264	58	1·780	1·641
29	1·340	1·278	59	1·795	1·655
30	1·355	1·288	60	1·810	1·667

(Calculated by Gerlach, Z. anal. **8**. 279, after Zimmermann, N. J. Pharm. **18**, **2**. 5, and Schiff, A. **107**. 300.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
4·2	1·0382	21·0	1·2008
8·4	1·0776	25·2	1·2439
12·6	1·1177	29·4	1·2880
16·8	1·1588	...	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
10	1·077	50	1·539
20	1·175	60	1·667
30	1·288	70	1·790
40	1·411	...	...

(Gerlach, Z. anal. **27**. 275, calculated from Schiff, A. **107**. 300.)

Sp. gr. of K_2O+Aq at 15°.

% K_2O	Sp. gr.	% K_2O	Sp. gr.
5	1·054	30	1·358
10	1·111	35	1·428
15	1·171	40	1·500
20	1·231	45	1·576
25	1·294	...	...

(Hager, Adjumenta varia, Leipsic, **1876**.)

Sp. gr. of KOH+Aq at 20° containing 2 mols. KOH to 100 mols. H_2O=1·05325. (Nicol, Phil. Mag. (5) **16**. 122.).

Sat. KOH+Aq boils at 157·7° (Griffiths); 340° (Gerlach).

B.-pt. of KOH+Aq containing pts. KOH to 100 pts. H_2O.

B.-pt.	Pts. KOH	B.-pt.	Pts. KOH
105°	20·5	215°	210·5
110	34·5	220	219·8
115	46·25	225	230·0
120	57·5	230	240·9
125	67·5	235	251·9
130	76·8	240	263·1
135	85·0	245	274·4
140	92·5	250	285·7
145	99·8	255	298·5
150	106·5	260	312·5
155	114·05	265	328·0
160	121·7	270	343·5
165	129·35	275	359·0
170	137·0	280	375·0
175	144·8	285	391·0
180	152·6	290	408·2
185	160·4	295	425·5
190	168·2	300	444·4
195	176·5	310	484·0
200	185·0	320	526·3
205	193·5	330	571·5
210	202·0	340	623·6

(Gerlach, Z. anal. **26**. 464.)

Abundantly sol. in strong alcohol or wood-spirit.

Readily sol. in glycerine.

Sol. in not less than 25 pts. of ether. (Boullay.) Sol. in much more than 25 pts. of ether. (Connell.)

Sol. in aqueous solution of mannite. (Favre, A. ch. (3) **11.** 76.)

Insol. in acetone. Readily sol. in fusel oil.

$+1\frac{1}{2}H_2O$.

$+2H_2O$. Very deliquescent, and sol. in H_2O with absorption of much heat.

Potassium iodide, KI.

Deliquescent only in very moist air. Very sol. in H_2O with absorption of heat.

The temp. of H_2O can be lowered 24° by dissolving KI. (Baup.)

140 pts. KI dissolved in 100 pts. H_2O at 10·8° lower the temp. 22·5°. (Rüdorff, Pogg. **136.** 276.)

100 pts. H_2O dissolve 126·6 pts. KI at 0° (Kremers); 127·8 pts. KI at 0° (Mulder); 127·9 pts. KI at 0° (Gerardin).

By boiling, 100 pts. H_2O dissolve 221 pts. KI at 120° (Baup); 222·2 pts. KI at 120° (Gay-Lussac); 222·6 pts. KI at 118·4° (Mulder); 223·58 pts. KI at 117° (Legrand); 223·6 pts. KI at 117° (Gerardin).

Between these temps. the solubility increases proportional to temp.

Sol. in 0·735 pt. H_2O at 12·5°; in 0·769 pt. H_2O at 16°; in 0·7 pt. H_2O at 18°; in 0·45 pt. H_2O at 120°. (Graham-Otto.)

100 pts. KI+Aq sat. at 15-16° contain 58·07 pts. KI. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O at 12·5° dissolve 136 pts.; at 16°, 141 pts. KI. (Baup.)

100 pts. H_2O at 18° dissolve 143 pts. KI; at 120°, 271 pts. (Gay-Lussac.)

Sol. in 0·79 pt. H_2O at 0°; in 0·70 pt. H_2O at 20°; in 0·63 pt. H_2O at 48°; in 0·57 pt. H_2O at 60°; in 0·53 pt. H_2O at 80°; in 0·51 pt. H_2O at 100°. (Kremers, Pogg. **97.** 15.)

Sol. in 0·71 pt. H_2O at 15°. (Eder, Dingl. **221.** 89.)

Solubility of KI in 100 pts. H_2O at t°.

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
0	127·9	19	143·4	38	159
1	128·7	20	144·2	39	160
2	129·6	21	145·1	40	160
3	130·4	22	145·9	41	161
4	131·2	23	146·7	42	162
5	132·1	24	147·5	43	163
6	132·9	25	148·3	44	164
7	133·7	26	149·1	45	164
8	134·5	27	149·9	46	165
9	135·3	28	150·7	47	166
10	136·1	29	151·5	48	167
11	137·0	30	152·3	49	168
12	137·8	31	153	50	168
13	138·6	32	154	51	169
14	139·4	33	155	52	170
15	140·2	34	156	53	171
16	141·0	35	156	54	172
17	141·8	36	157	55	172
18	142·6	37	158	56	173

Solubility of KI in 100 pts., etc.—*Continued.*

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
57	174	78	191	99	208
58	175	79	192	100	209
59	175	80	192	101	210
60	176	81	193	102	211
61	177	82	194	103	212
62	178	83	195	104	213
63	179	84	196	105	213
64	180	85	197	106	214
65	180	86	197	107	215
66	181	87	198	108	216
67	182	88	199	109	217
68	183	89	200	110	218
69	184	90	201	111	219
70	184	91	202	112	220
71	185	92	202	113	220
72	186	93	203	114	221
73	187	94	204	115	222
74	188	95	205	116	223
75	188	96	206	117	223·6
76	189	97	207	...	...
77	190	98	208	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 63.)

Solubility of KI in 100 pts. H_2O at t°.

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
−22·65	107·2	21·05	143·3	71·1	183·5
−22·35	106·6	25·6	146·6	74·75	185·6
−16·8	111·1	29·1	149·6	81·6	192·0
−11·35	116·3	37·3	156·7	86·35	194·6
− 5·9	120·4	42·3	160·3	93·5	200·3
0	126·1	45·75	163·6	100·7	205·6
+ 3·25	130·1	51·8	167·6	110·2	216·1
9·55	134·0	55·05	169·1	113·7	218·8
12·75	137·1	60·55	173·4	...	...
12·9	137·9	65·0	178·3	...	...

(Coppet, A. ch. (5) **30.** 417.)

Solubility is represented by a straight line of the formula 126·23 + 0·8088t. (Coppet.)

Solubility of KI in 100 pts. H_2O at high temp.

t°	Pts. KI	t°	Pts. KI
124	233·9	144	264·6
133	249·3	175	310·4

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

If solubility S = pts. KI in 100 pts. solution, S = 55·8 + 0·122t from 0° to 165°. (Étard, C. R **98.** 1432.)

Sp. gr. of KI + Aq at 21°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
1	1·0075	6	1·0464	11	1·0877
2	1·0151	7	1·0545	12	1·0962
3	1·0227	8	1·0627	13	1·1048
4	1·0305	9	1·0710	14	1·1136
5	1·0384	10	1·0793	15	1·1226

Sp. gr. of KI, etc.—*Continued.*

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
16	1·1318	31	1·2899	46	1·4982
17	1·1412	32	1·3017	47	1·5142
18	1·1508	33	1·3138	48	1·5305
19	1·1605	34	1·3262	49	1·5471
20	1·1705	35	1·3389	50	1·5640
21	1·1807	36	1·3519	51	1·5810
22	1·1911	37	1·3653	52	1·5984
23	1·2016	38	1·3791	53	1·6162
24	1·2122	39	1·3933	54	1·6343
25	1·2229	40	1·4079	55	1·6528
26	1·2336	41	1·4224	56	1·6717
27	1·2445	42	1·4371	57	1·6911
28	1·2556	43	1·4520	58	1·7109
29	1·2699	44	1·4671	59	1·7311
30	1·2784	45	1·4825	60	1·7517

(Schiff, A. **110.** 75.)

Sp. gr. of KI + Aq. S = according to Schiff (A. **108.** 340) at 21°; K = according to Kremers (Pogg. **96.** 62), interpolated by Gerlach (Z. anal. **8.** 285).

	5	10	15	20	25	30 % KI,
S	1·038	1·079	1·123	1·171	...	1·279
K	1·038	1·078	1·120	1·166	1·218	1·271

	35	40	45	50	55	60 % KI.
S	...	...	1·483	...	...	...
K	1·331	1·396	1·469	1·546	1·636	1·734

Sp. gr. of KI + Aq at 18°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
5	1·0363	30	1·273	55	1·630
10	1·0762	40	1·3966	...	...
20	1·1679	50	1·545	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

B.-pt. of KI + Aq containing pts. KI to 100 pts. H_2O.

B.-pt.	Pts. KI	B.-pt.	Pts. KI	B.-pt.	Pts. KI
101°	15	108°	111·5	115	185°
102	30	109	123	116	195
103	45	110	134	117	205
104	60	111	145	118	215
105	74	112	155	118·5	220
106	87	113	165	...	...
107	99·5	114	175	...	...

(Gerlach, Z. anal. **26.** 439.)

Sat. KI + Aq boils at 119°. (Kremers.)

Sat. KI + Aq forms a crust at 117·5°, and contains 210 pts. KI to 100 pts. H_2O; highest temp. observed, 118·5°. (Gerlach, Z. anal. **26.** 426.)

100 pts. H_2O dissolve 133·2 pts. KI and 10·4 pts. KCl. (Rüdorff, B. **6.** 484.)

KI + Aq sat. at 14·5° containing 139·8 pts. KI to 100 pts. H_2O dissolves 1·0 pt. K_2SO_4 with separation of 2·2 pts. KI, so that solution contains 137·6 pts. KI and 1·0 pt. K_2SO_4 to 100 pts. H_2O. (Mulder, Rotterdam, **1864.**)

100 pts. H_2O dissolve 86·3 pts. KI and 2·1 pts. Na_2SO_4 at 14·5°. (Mulder, J. B. **1866.** 67.)

100 pts. alcohol of 0·85 sp. gr. dissolve 18 pts. KI at 12·5°. 100 pts. absolute alcohol dissolve 2·5 pts. KI at 13·5°. Much more sol. in hot alcohol. (Baup.)

100 pts. alcohol of D sp. gr. at 0° dissolve at 18°—

D	0·9904	0·9851	0·9726	0·9665	0·9528
	130·5	119·4	100·1	89·9	76·9 pts. KI,
D	0·9390	0·9088	0·8464	0·8322	
	66·4	48·2	11·4	6·2 pts. KI.	

That is, aqueous alcohol dissolves approximately the same amount of KI that the water present in the alcohol would dissolve, and it is therefore probable that KI is insol. in strictly absolute alcohol. (Gerardin.)

Solubility in 100 pts. alcohol of 0·9496 sp. gr. at:

8°	13°	25°	46°	55°	62°
67·4	69·2	75·1	84·7	87·5	90·2 pts. KI.

(Gerardin, A. ch. (4) **5.** 155.)

Sol. in 68·3 pts. absolute alcohol (Eder, Dingl. **221.** 89); in 370 pts. ether (sp. gr. 0·729), (Eder, *l.c.*); in 120 pts. alcohol-ether (1 : 1), (Eder, *l.c.*)

Sol. in 10-12 pts. 90 % alcohol, and 40 pts. absolute alcohol. (Hager, Comm. **1883.**)

Alcoholic solution can be mixed with ½ vol. ether without pptn.

100 pts. absolute methyl alcohol dissolve 16·5 pts. at 20·5°; 100 pts. absolute ethyl alcohol dissolve 1·75 pts. at 20·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. acetone dissolve 2·930 pts. KI at 25°. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Freely sol. in glycerine. Insol. in acetic acid. (Berthemot.)

Sol. in 3 pts. glycerine; insol. in olive oil. (Cap and Garot.)

Potassium *tri*iodide, KI_3.

Very deliquescent; very sol. in H_2O and alcohol. (Johnson, Chem. Soc. **1877, 1.** 249.)

Solution of I in KI contains this salt (see Iodine). Decomp. by heat or shaking with CS_2, ether, chloroform. Sol. in alcohol, from which CS_2 does not remove I. (Jörgensen, J. pr. (2) **2.** 347.)

Potassium silver iodide, KI, AgI.

Sol. in KI + Aq. Sol. in hot alcohol. (Boullay, A. ch. **34.** 377.)

2KI, AgI. Sol. in KI + Aq. Decomp. by H_2O. (Boullay.)

Potassium silver *poly*iodide, AgK_3I_{12}, $3KI + 5H_2O$.

Very deliquescent. (Johnson, Chem. Soc. **33.** 183.)

Potassium tellurium iodide.

See **Iodotellurate, potassium.**

Potassium thallic iodide, KI, TlI_3.

Decomp. by H_2O. Can be crystallised from alcohol. (Willm.)

$3KI, 2TlI_3+3H_2O$. Partially decomp. by H_2O. (Rammelsberg.)

Potassium stannous iodide, $KI, SnI_2+1\frac{1}{2}H_2O$.

When treated with a small quantity of H_2O, KI dissolves out; but when more H_2O is added, the substance is completely dissolved. More sol. in warm than cold alcohol. (Boullay.)

Potassium zinc iodide, KI, ZnI_2.

Very deliquescent. (Rammelsberg, Pogg. **43.** 665.)

Potassium nitride, K_2N.

Decomp. violently by H_2O. (H. Davy.)

Potassium *sub*oxide.

Decomposes H_2O.

Does not exist. (Lupton, Chem. Soc. **1876,** **2.** 565.)

Potassium oxide, K_2O.

Very sol. in H_2O with much heat.

See **Potassium hydroxide.**

Potassium *di*oxide, K_2O_2.

Deliquescent. Sol. in H_2O.

Forms compound $K_2O_2, 2H_2O_2$. (Schöne, A. **193.** 241.)

Potassium *per*oxide, K_2O_4.

Deliquescent. Very sol. with decomp. in H_2O.

Potassium silicon oxyfluoride, $SiF_2(OK)_2$ and $SiO(F)OK$.

(Schiff and Bechi, A. Suppl. **4.** 33.)

Potassium tantalum oxyfluoride, $K_4Ta_4O_5F_{14}$.

Insol. in boiling water. Easily sol. in HF + Aq. (Marignac, A. ch. (4) **9.** 268.)

Potassium phosphide.

Decomposes H_2O.

Potassium phosphoselenide, $KSeP=K_2Se, P_2Se$.

Sol. in cold H_2O with rapid decomp. Sol. in alcohol with slight decomp. (Hahn, J. pr. **93.** 430.)

Potassium phospho*tri*selenide, $2K_2Se, P_2Se_3$.

Deliquescent. Decomp. violently with H_2O. Sol. in alcohol or ether, or in a mixture of the two, with slight decomp., but decomp. gradually on the air. (Hahn, J. pr. **93.** 430.)

Potassium phospho*penta*selenide, $K_4P_2Se_7=2K_2Se, P_2Se_5$.

Deliquescent; immediately decomp. by H_2O, alcohol, or ether. (Hahn.)

Potassium phosphosulphide, $4K_2S_2, P_2S_3$.

Deliquescent. Sol. in H_2O with decomp.

Potassium selenide, K_2Se.

Sol. in H_2O with subsequent decomp. on the air.

$+9$, 14, or $19H_2O$. (Fabre, C.R. **102.** 613.)

Potassium *mono*sulphide, K_2S.

Deliquescent. Sol. in H_2O and alcohol. H_2O solution decomp. on air.

Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 81.)

$+5H_2O$. (Schöne, Pogg. **131.** 380.)

All potassium sulphides are sol. in glycerine; insol. in ether and ethyl acetate.

Potassium *di*sulphide, K_2S_2.

Sol. in H_2O and alcohol, with gradual decomp.

Potassium *tri*sulphide, K_2S_3.

Sol. in H_2O and alcohol, with gradual decomp. on the air.

Potassium *tetra*sulphide, K_2S_4.

Sol. in H_2O and alcohol.

$+2H_2O$. Sol. in H_2O. Sl. sol. in alcohol.

$+8H_2O$. Sol. in H_2O. Alcohol takes out water. (Schöne.)

Potassium *penta*sulphide, K_2S_5.

Sol. in H_2O and alcohol.

Potassium palladium sulphide.

See **Sulphopalladate, potassium.**

Potassium platinum sulphide.

See **Sulphoplatinate, potassium.**

Potassium rhodium sulphide, $3K_2S, Rh_2S_3$.

Decomp. by H_2O. (Leidié.)

Potassium tellurium sulphide.

See **Sulphotellurate, potassium.**

Potassium thallium sulphide, K_2S, Tl_2S_3.

Not decomposed by H_2O, or hot NH_4OH, or KOH + Aq. Decomp. by HCl or moderately conc. H_2SO_4 + Aq. Hot HNO_3 + Aq decomp. with separation of S. (Schneider, J. pr. **110.** 168.)

Potassium stannic sulphide.

See **Sulphostannate, potassium.**

Potassium zinc sulphide, $K_2S, 3ZnS$.

Not attacked by H_2O, but easily decomp. by the most dil. acids. (Schneider, J. pr. (2) **8.** 29.)

Potassium telluride, K_2Te.

Sol. in H_2O. (Demarçay, Bull. Soc. (2) **40.** 99.)

Praseocobaltic chloride, $Co(NH_3)_4Cl_3+H_2O$.

Easily sol. in H_2O.

Dil. HCl + Aq dissolves traces; conc. HCl + Aq dissolves more. Sol. in NH_4OH + Aq with decomp. Sol. in conc. H_2SO_4 without decomp. Sl. sol. in dil. H_2SO_4 + Aq. (Rose.)

—— **mercuric chloride,** $Co(NH_3)_4Cl_3, HgCl_2$.

Sl. sol. in cold H_2O; insol. in $HgCl_2$ + Aq. (Vortmann, B. **15.** 1892.)

—— **chloride chromate,** $[CoCl_2(NH_3)_4]_2Cr_2O_7+H_2O$.

Scarcely sol. in cold, easily sol. in warm H_2O. (Vortmann, B. **15.** 1897.)

Praseocobaltic chloride nitrate, $CoCl_2(NH_3)_4NO_3+H_2O$.

Much less sol. in H_2O than the chloride. Precipitated from aqueous solution by dil. HNO_3+Aq. (Vortmann, B. **15**. 1896.)

Praseodymium.

See under **Didymium.**

Praseodymium oxide, Pr_2O_3.

Easily sol. in H_2O. (v. Welsbach, M. **6**. 477.)

Praseodymium *per*oxide, Pr_4O_7.

Sol. in acids with evolution of O. (v. Welsbach.)

Purpureocobaltic salts.

For other purpureocobaltic salts, *see*—

Chloropurpureocobaltic salts.
Bromopurpureocobaltic salts.
Nitratopurpureocobaltic salts.
Sulphatopurpureocobaltic salts.

Purpureocobaltic cobalticyanide, $Co(NH_3)_5Co(CN)_6+1\frac{1}{2}H_2O$.

Insol. in H_2O.

—— **ferricyanide,** $Co(NH_3)_5Fe(CN)_6$.

Insol. in cold H_2O. Probably belongs to roseo series.

—— **mercuric hydroxychloride,** $CoN_5H_{11}(HgCl)_2(HgOH)Cl_3$.

Ppt. (Vortmann and Morgulis, B. **22**. 2645.)

$CoN_5H_{11}(HgOH)_4Cl_3$. Ppt. (V. and M.)

—— **mercuriodide, basic,** $CoN_5H_{11}(HgI_2)_2(HgOH)_3I_3$.

Ppt. Sl. sol. in acids. Sol. in KI+Aq. (Vortmann and Borsbach, B. **23**. 2804.)

—— **molybdate,** $Co_2O_3(NH_3)_{10}$, $7MoO_3+3H_2O$ (?).

Insol. in H_2O or dil. $HC_2H_3O_2$+Aq. (Carnot, C. R. **109**. 109.)

—— **sulphate.**

See **Sulphatopurpureocobaltic salts.**

—— **tungstate,** $Co(NH_3)_5O(WO_4)$.

Scarcely sol. in cold or hot H_2O. (Gibbs.)

$Co_2O_3(NH_3)_{10}$, $10WO_3+9H_2O$ (?). Insol. in H_2O, or dil. $HC_2H_3O_2$+Aq, or NH_4OH+Aq. (Carnot, C. R. **109**. 147.)

—— **vanadate,** $Co_2O_3(NH_3)_{10}, 5V_2O_5+9H_2O$ (?).

Ppt. Insol. in H_2O. (Carnot, C. R. **109**. 147.)

Purpureocobaltic octamine salts.

See **Octamine cobaltic purpureo salts.**

Pyrosulphuric acid, $H_2S_2O_7$.

See ***Di*sulphuric acid.**

Rhodicyanhydric acid, $H_3Rh(CN)_6$.

Not known in the free state.

Potassium rhodicyanide, $K_3Rh(CN)_6$.

Sol. in H_2O. Easily decomp. by acids.

Rhodium, Rh.

Insol. in all acids, including aqua regia.

Rhodium "sponge" is sol. in HNO_3+Aq, and somewhat in HCl+Aq when exposed to air.

Rhodium ammonia compounds.

See—

Bromopurpureorhodium comps., $BrRh(NH_3)_5X_2$.
Chloropurpureorhodium comps., $ClRh(NH_3)_5X_2$.
Iodopurpureorhodium comps., $IRh(NH_3)_5X_2$.
Luteorhodium comps., $Rh(NH_3)_6X_3$.
Nitratopurpureorhodium comps., $(NO_3)Rh(NH_3)_5X_2$.
Roseorhodium comps., $Rh(NH_3)_5(OH_2)X_3$.
Xanthorhodium comps., $(NO_2)Rh(NH_3)_5X_2$.

Rhodium *di*chloride, $RhCl_2$ (?).

Insol. in H_2O, HCl, or HNO_3+Aq. Not attacked by boiling KOH or K_2CO_3+Aq. (Fellenberg.)

Decomp. by boiling KOH+Aq. (Berzelius.)

Does not exist. (Leidié, C. R. **106**. 1076.)

Rhodium *tri*chloride, $RhCl_3$.

Insol. in acids, even aqua regia. When boiled for a long time with KOH+Aq, it becomes sl. sol. in HCl+Aq.

$+4H_2O$. Very sl. deliquescent. Easily sol. in H_2O, HCl+Aq, or alcohol. Insol. in ether. Decomp. by H_2SO_4 only when boiling. (Claus, J. pr. **80**. 282.)

No definite amount of crystal H_2O. (Leidié, A. ch. (6) **17**. 271.)

Rhodium chloride *with* MCl.

See **Chlororhodite, M.**

Rhodium *di*hydroxide, RhO_2, $2H_2O$, *or* **Rhodium rhodate,** Rh_2O_3, RhO_3+6H_2O.

Sol. in HCl+Aq.

Rhodium *sesqui*hydroxide, $Rh_2O_6H_6$.

Only sl. sol. in conc. HCl+Aq. (Claus.)

$+2H_2O$. Easily sol. in HCl, H_2SO_4, H_2SO_3, HNO_3, or HSCN+Aq; also when moist, in $HC_2H_3O_2$+Aq. Sol. in conc. KOH+Aq; very sl. sol. in H_3BO_3, H_3PO_4, $H_2C_4H_4O_6$, and HCN+Aq. Sol. in acid alkali oxalates+Aq. (Leidié, C. R. **107**. 234.)

Rhodium *mon*oxide, RhO.

Not attacked by acids. (Deville and Debray, A. ch. (3) **61**. 83.)

Rhodium *sesqui*oxide, Rh_2O_3.

Insol. in H_2O, boiling KOH+Aq, or any acid, even aqua regia. (Claus.)

Rhodium *di*oxide, RhO_2.

Insol. in all acids or alkalies.

Rhodium *tri*oxide, RhO_3.

"Rhodic acid." Known only in solution of "Potassium rhodate," which is very easily decomp. (Claus.)

Rhodium *mono*sulphide, RhS.

Insol. in aqua regia.

Rhodium *sesqui*sulphide, Rh_2S_3.

Sol. in alkali sulphides + Aq. (Debray, C. R. **97.** 1332.)

Insol. in alkali sulphides + Aq. Not attacked by HNO_3, aqua regia, or Br_2 + Aq. (Leidié, Bull. Soc. (2) **50.** 664.)

Rhodium sodium sulphide, $3Na_2S, Rh_2S_3$.

Decomp. by H_2O. (Leidié.)

Rhodium *sesqui*sulphydroxide, $Rh_2S_6H_6$.

Easily sol. in aqua regia or Br_2 + Aq. Insol. in alkali sulphides + Aq or acids. (Leidié, Bull. Soc. (2) **50.** 664.)

Rhodochromium bromide,

$HOCr_2(NH_3)_{10}Br_5 + H_2O$.

Rather difficultly sol. in H_2O. Decomp. by boiling or standing. Sol. in NH_4OH + Aq or NaOH + Aq. Insol. in dil. HBr + Aq, KBr + Aq, or alcohol. (Jörgensen, J. pr. (2) **25.** 321.)

—— **bromide, basic,** $HOCr_2(NH_3)_{10}(OH)Br_4 + H_2O$.

Sl. sol. in H_2O. Sol. in NH_4OH or NaOH + Aq. Insol. in alcohol. (Jörgensen.)

—— **bromoplatinate,** $HOCr_2(NH_3)_{10}Br_3PtBr_6$, $HOCr_2(NH_3)_{10}Br(PtBr_6)_2 + 4H_2O$.

Ppt. (Jörgensen.)

—— **chloraurate,** $HOCr_2(NH_3)_{10}Cl_3(AuCl_4)_2 + 2H_2O$.

Difficultly sol. but not insol. in H_2O. (Jörgensen).

—— **chloride,** $HOCr_2(NH_3)_{10}Cl_5 + H_2O$.

Sol. in about 40 pts. of cold H_2O. Insol. in cold dil. HCl + Aq, NH_4Cl + Aq, or alcohol. Sol. in NH_4OH + Aq. (Jörgensen, J. pr. (2) **25.** 321.)

—— **chloroiodide, basic,** $HOCr_2(NH_3)_{10}(OH)Cl_2I_2$.

Sl. sol. in cold H_2O; insol. in alcohol. (Jörgensen.)

—— **chloroplatinate,** $HOCr_2(NH_3)_{10}Cl_3PtCl_6$, $HOCr_2(NH_3)_{10}Cl(PtCl_6)_2 + 4H_2O$.

Precipitate. (Jörgensen.)

—— **dithionate,** $[HOCr_2(NH_3)_{10}]_2(S_2O_6)_5 + 2H_2O$.

Nearly insol. in H_2O.

—— **dithionate, basic,** $HOCr_2(NH_3)_{10}OH(S_2O_6)_2 + H_2O$.

Insol. in H_2O, cold NH_4OH + Aq, or NaOH + Aq.

—— **iodide,** $HOCr_2(NH_3)_{10}I_5 + H_2O$.

Very difficultly sol. in H_2O. Insol. in very dil. HI + Aq or alcohol. Sl. sol. in NH_4OH or KOH + Aq. (Jörgensen.)

—— **nitrate,** $HOCr_2(NH_3)_{10}(NO_3)_5$.

Rather difficultly sol. in H_2O, from which it is precipitated by a few drops of HNO_3 + Aq. Sol. in hot dil. NH_4OH + Aq.

—— **nitrate chloroplatinate,** $HOCr_2(NH_3)_{10}(NO_3)(PtCl_6)_2 + 4H_2O$.

Precipitate. (Jörgensen.)

Rhodochromium sulphate, $[HOCr_2(NH_3)_{10}]_2(SO_4)_5 + 2H_2O$.

Very sl. sol. in cold H_2O. Easily sol. in cold dil. H_2SO_4 + Aq.

Almost insol. in a mixture of 3 vols. H_2O, 1 vol. alcohol, and ⅓ vol. dil. H_2SO_4 + Aq. (Jörgensen.)

Rhodonitrous acid.

Ammonium rhodonitrite, $(NH_4)_6Rh_2(NO_2)_{12}$.

Nearly insol. in cold, sl. sol. in hot H_2O. Insol. in conc. NH_4Cl or $NH_4C_2H_3O_2$ + Aq. Insol. in alcohol. (Leidié, C. R. **111.** 108.)

Barium rhodonitrite, $Ba_3Rh_2(NO_2)_{12}$.

Sl. sol. in cold, more easily in hot H_2O. (Lamy.)

+ $12H_2O$. Sol. in 50 pts. H_2O at 16°, and 6·5 pts. at 100°. (Leidié, C. R. **111.** 108.)

Potassium rhodonitrite, $K_6Rh_2(NO_2)_{12}$.

Nearly insol. in cold, very sl. sol. in boiling H_2O. Completely insol. in KNO_2 + Aq, and in KCl + Aq (30 % KCl), or $KC_2H_3O_2$ + Aq (50 % $KC_2H_3O_2$). Insol. in alcohol. (Leidié, C. R. **111.** 106.)

Sodium rhodonitrite, $Na_6Rh_2(NO_2)_{12}$.

Sol. in 2½ pts. H_2O at 17°, and 1 pt. at 100°. Insol. in alcohol. Decomp. by HCl + Aq. (Leidié, C. R. **111.** 107.)

Rhodosochromium bromide.

Sol. in H_2O; insol. in dil. HBr + Aq (1:1). (Jörgensen, J. pr. (2) **45.** 260.)

—— **chloraurate,** $Cr_2(NH_3)_6(HO)_3Cl_3$, $2AuCl_3 + 2H_2O$.

Not insol. in cold H_2O. (Jörgensen.)

—— **chloride,** $Cr_2(NH_3)_6(HO)_3Cl_3 + 2H_2O$.

Sol. in 10·6 pts. H_2O at 18°; decomp. by boiling. Pptd. by ½ to 1 vol. dil. HCl + Aq. Sol. in cold dil. NH_4OH + Aq. (Jörgensen, J. pr. (2) **45.** 260.)

—— **chloroplatinate,** $2Cr_2(NH_3)_6(OH)_3Cl_3$, $3PtCl_4 + 6H_2O$.

Insol. in H_2O. (Jörgensen.)

$Cr_2(NH_3)_6(OH)_3Cl_3$, $2PtCl_4 + 2H_2O$. Insol. in 95 % alcohol. (Jörgensen.)

—— **chromate,** $[Cr_2(NH_3)_6(OH)_3]_2(CrO_4)_3 + 7H_2O$. (Jörgensen.)

Very sl. sol. in H_2O. (Jörgensen.)

—— **iodide,** $Cr_2(NH_3)_6(OH)_3I_3 + 2H_2O$.

Sol. in H_2O. Insol. in dil. HI + Aq. (Jörgensen.)

—— **nitrate,** $Cr_2(NH_3)_6(OH)_3(NO_3)_3 + H_2O$.

Much less sol. in cold H_2O than the chloride. Insol. in dil. HNO_3 + Aq. (Jörgensen.)

—— **oxalate,** $[Cr_2(NH_3)_6(OH)_3]_2(C_2O_4)(HC_2O_4)_4 + 2H_2O$.

Sol. in cold H_2O, but not very easily. (Jörgensen.)

Rhodosochromium sulphate,
$[Cr_2(NH_3)_6(OH)_3]_2(SO_4)_3+5H_2O$.

Very sl. sol. in cold H_2O. Easily sol. in dil. NH_4Cl + Aq. (Jörgensen.)

$[Cr_2(NH_3)_6(OH)_3]SO_4$, $HSO_4+1\frac{1}{2}H_2O$. Decomp. by H_2O into H_2SO_4 and above compound. (Jörgensen.)

—— ***per*sulphide,** $[Cr_2(NH_3)_6(OH)_3]_2S_{11}+4H_2O$.

Ppt. Insol. in H_2O. (Jörgensen.)

Rhodosulphuric acid.

Potassium rhodosulphate, $K_6Rh_2(SO_4)_6$.

Two modifications:

(*a*) Slowly sol. in cold, easily in hot H_2O.

(*b*) Insol. in H_2O.

Does not exist. (Leidié, C. R. **107**. 234.)

Sodium rhodosulphate.

Insol. in H_2O, HCl, HNO_3, or aqua regia. (Claus.)

Does not exist. (Leidié.)

$Na_2Rh_2(SO_4)_4$. Insol. in H_2O. (Seubert and Kobbé, B. **23**. 2560.)

Rhodosulphurous acid.

Potassium rhodosulphite, $K_6Rh_2(SO_3)_5+6H_2O$.

Nearly insol. in H_2O. Slowly sol. in acids. Not decomp. by boiling KOH + Aq. (Claus.)

Sodium rhodosulphite,
$Na_6Rh_2(SO_3)_5+4\frac{1}{2}H_2O=3Na_2SO_3, 2RhSO_3$.

Insol. in cold, very sl. sol. in hot H_2O. Easily sol. in HNO_3 + Aq. (Seubert and Kobbé, B. **23**. 2558.)

Roseochromium bromide,
$Cr(NH_3)_5Br_3+H_2O$.

Easily sol. in H_2O. Insol. in HBr + Aq. (Christensen, J. pr. (2) **23**. 26.)

—— **bromochromate,** $Cr(NH_3)_5Br(CrO_4)$.

Somewhat sol. in H_2O, but decomp. on standing. (Jörgensen, J. pr. (2) **25**. 398.)

—— **bromoplatinate,** $Cr(NH_3)_5Br(PtBr_6)+2H_2O$.

Precipitate. Difficultly sol. in H_2O. (Christensen, *l.c.*)

—— **chloride,** $Cr(NH_3)_5Cl_3+H_2O$.

Easily sol. in H_2O with subsequent decomp. Insol. in alcohol. (Christensen, J. pr. (2) **23**. 26.)

—— **mercuric chloride,** $Cr(NH_3)_5Cl_3, 3HgCl_2+2H_2O$.

Sl. sol. in H_2O. Sol. in dil. HCl + Aq with decomposition. (Christensen, *l.c.*)

—— **dithionate, basic,** $Cr(NH_3)_5(OH)_2S_2O_6+H_2O$.

Easily sol. in very dil. HCl + Aq. (Jörgensen, J. pr. (2) **25**. 398.)

—— **iodide,** $Cr(NH_3)_5I_3$.

Easily sol. in H_2O; decomp. by boiling. (Christensen, *l.c.*)

Roseochromium nitrate,
$Cr(NH_3)_5(NO_3)_3+H_2O$.

Rather easily sol. in H_2O. (Christensen, *l.c.*)

$Cr(NH_3)_5(NO_3)_3(OH_2)_2$, HNO_3. Decomp. by H_2O or alcohol. (Jörgensen, J. pr. (2) **44**. 63.)

—— **sulphate,** $[Cr(NH_3)_5]_2(SO_4)_3+5H_2O$.

Easily sol. in H_2O. Precipitated by alcohol. (Christensen, *l.c.*)

—— **sulphate bromoplatinate,**
$[Cr(NH_3)_5(SO_4)]_2PtBr_6$.

Difficultly sol. in H_2O. (Christensen, *l.c.*)

—— **sulphate chloroplatinate,**
$[Cr(NH_3)_5(SO_4)]_2PtCl_6$.

Difficultly sol. in H_2O. (Christensen, *l.c.*)

Roseocobaltic bromide, $Co(NH_3)_5(OH_2)Br_3$.

Sol. in H_2O; insol. in HBr + Aq. (Jörgensen, J. pr. (2) **31**. 49.)

—— **bromoplatinate,** $Co(NH_3)_5(OH_2)Br_3$, $PtBr_4+H_2O$.

Somewhat sol. in H_2O or dil. alcohol. Insol. in strong alcohol. (Jörgensen.)

$2Co(NH_3)_5(OH_2)Br_3$, $3PtBr_4+4H_2O$. Ppt. (Jörgensen.)

—— **bromosulphate,** $Co(NH_3)_5(OH_2)Br(SO_4)$.

Sol. in H_2O. (Krok.)

—— **bromosulphate bromaurate,**
$Co(NH_3)_5(OH_2)(SO_4)Br$, $AuBr_3$.

—— **carbonate.**

Very sol. in H_2O.

—— **chloraurate,** $Co(NH_3)_5(OH_2)Cl_3$, $AuCl_3$.

Moderately sol. in cold H_2O.

—— **chloride,** $Co(NH_3)_5(OH_2)Cl_3$.

Sol. in 4·8 pts. H_2O at 10·1°, but decomp. on heating.

100 pts. H_2O dissolve 16·12 pts. at 0°, and 24·87 pts. at 16·19°. (Kurnakoff, J. russ. Soc. **24**. 269.)

Sl. sol. in 1000 pts. fuming HCl + Aq, more easily in 20 % HCl + Aq. (Rose.)

—— **mercuric chloride,**
$Co(NH_3)_5(OH_2)Cl_3, 3HgCl_2+H_2O$.

More easily sol. in solvents than the anhydrous purpureo salt. (Carstanjen.)

$Co(NH_3)_5(OH_2)Cl_3$, $HgCl_2$. Sol. in HCl + Aq with decomp. into above salt. (Jörgensen.)

—— **chloroplatinate,**
$Co(NH_3)_5(OH_2)Cl_3$, $PtCl_4+\frac{1}{2}H_2O$.

Decomp. by H_2O. (Jörgensen.)

$2Co(NH_3)_5(OH_2)Cl_3$, $PtCl_4+2H_2O$. Decomp. by H_2O.

$2Co(NH_3)_5(OH_2)Cl_3$, $3PtCl_4+6H_2O$. Not difficultly sol. in warm H_2O. (Gibbs.)

$Co(NH_3)_5Cl_3$, $PtCl_4+H_2O$. (Gibbs.)

—— **chlorosulphate,** $Co(NH_3)_5Cl(SO_4)$.

Easily sol. in H_2O.

—— **chlorosulphate mercuric chloride,**
$Co(NH_3)Cl_5(SO_4)$, $HgCl_2+3H_2O$.

Sol. in hot H_2O, and can be recrystallised without decomp. (Krok.)

Roseocobaltic *di*chromate,
$[Co(NH_3)_5]_2(Cr_2O_7)_3+5H_2O$.

Can be recrystallised out of weak acetic acid.

—— **cobalticyanide,** $Co(NH_3)_5(OH_2)Co(CN)_6$.

Nearly absolutely insol. in cold H_2O. (Jörgensen.)

$+H_2O$. (Gibbs and Gentele.)

—— **dithionate,** $Co(NH_3)_5(S_2O_6)(OH)$.

Decomp. by H_2O. (Rammelsberg, Pogg. **58.** 296.)

$Co(NH_3)_5(OH_2)(S_2O_6)+2H_2O$. Ppt. (Jörgensen.)

—— **hydroxide,** $Co(NH_3)_5(OH)_3$.

Known only in aqueous solution.

—— **mercuric hydroxychloride,**
$CoN_5H_{12}(HgOH)_3Cl_3$.

Ppt. Sol. in dil. acids. (Vortmann and Morgulis, B. **22.** 2646.)

$CoN_5H_{12}(HgOH)_3Cl_2(OH)$. Ppt. Sol. in dil. acids. (Vortmann and Morgulis.)

—— **iodide,** $Co(NH_3)_5(OH_2)I_3$.

Less sol. in H_2O than bromide. Insol. in HI + Aq. (Jörgensen.)

—— **iodosulphate,** $Co(NH_3)_5(OH_2)I(SO_4)$.

Easily sol. in H_2O. (Krok.)

—— **mercuriodide,** $[CoN_5H_{13}]_2(HgI)_3I_6$.

Ppt. (Vortmann and Borsbach, B. **23.** 2805.)

$CoN_5H_{13}(HgI)_2I_3$. Ppt. (Vortmann and Borsbach.)

$CoN_5H_{13}(HgI)_2I_2(OH)$. Ppt.

—— **nitrate,** $Co(NH_3)_5(OH_2)(NO_3)_3$.

Three modifications:

α. Sol. in 20 pts. H_2O at 15°. (Jörgensen.)

β. Known only in solution. Insol. in cold HNO_3 + Aq. (Gibbs.)

γ. Easily sol. in hot H_2O. (Gibbs.) (Purpureo salt ?)

$Co(NH_3)_5(OH_2)(NO_3)_3$, HNO_3. Decomp. by H_2O or alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— **nitrate chloroplatinate,**
$Co(NH_3)_5(OH_2)(NO_3)Cl_2$, $PtCl_4+H_2O$.

Ppt. (Jörgensen.)

—— **nitratosulphate,**
$Co(NH_3)_5(OH_2)(NO_3)(SO_4)$.

Sl. sol. in cold, easily in hot H_2O.

—— **oxalate,** $[Co(NH_3)_5(OH_2)]_2(C_2O_4)_3+2H_2O$.

Nearly insol. in H_2O.

$[Co(NH_3)_5]_2(C_2O_4)_3$, $4H_2C_2O_4$.

—— **oxalochloroplatinate,** $[Co(NH_3)_5]_2C_2O_4Cl_2$, $PtCl_4$.

Sol. in hot H_2O.

—— **oxalosulphate,** $[Co(NH_3)_5]_2(SO_4)_2C_2O_4$, $H_2C_2O_4+2H_2O$.

Sol. in hot H_2O.

$[Co(NH_3)_5]_2(SO_4)_2(C_2O_4)(OH)_2+6H_2O$. Sl. sol. in H_2O.

—— ***ortho*phosphate,**
$Co(NH_3)_5(OH_2)(PO_4H)(OH)+xH_2O$.

Nearly insol. in H_2O.

$[Co(NH_3)_5(OH_2)]_2(PO_4H)_3+4H_2O$. Very sl. sol. in cold H_2O; easily in H_2O containing HCl. (Jörgensen.)

Roseocobaltic *pyro*phosphate,
$[Co(NH_3)_5(OH_2)]_4(P_2O_7)_3+12H_2O$.

Insol. in H_2O. (Jörgensen.)

$Co(NH_3)_5(OH_2)(P_2O_7Na)+12H_2O$. Nearly insol. in cold, easily sol. in hot H_2O containing NH_4OH. (Jörgensen, J. pr. (2) **23.** 252.)

—— **sulphate,** $[Co(NH_3)_5(OH_2)]_2(SO_4)_3+3H_2O$.

Three modifications:

α. Sl. sol. in cold H_2O. Sol. in 58 pts. at 27° (Gibbs); 83·5 pts. at 20·2°, and 94·6 pts. at 17·2° (Jörgensen); more easily sol. in hot H_2O, and still more easily in NH_4OH + Aq.

β. Sol. in 1-2 pts. H_2O. (Gibbs.)

γ. Less sol. than luteosulphate. (Jörgensen.)

$+2H_2O$. Easily sol. in H_2O. (Vortmann.)

—— **sulphate, acid,**
$[Co(NH_3)_5]_2(SO_4)_3$, $2H_2SO_4+3H_2O$ (Fremy), or $4[Co(NH_3)_5]_2(SO_4)_3$, $9H_2SO_4+11H_2O$ (Jörgensen).

More easily sol. in H_2O than neutral sulphate, into which it is converted by recrystallisation. Sol. in about 13 pts. H_2O. (Jörgensen.)

—— **cerium sulphate,**
$[Co(NH_3)_5(OH_2)]_2(SO_4)_3$, $Ce_2(SO_4)_3+2\frac{1}{2}H_2O$.

Sl. sol. in cold, practically insol. in boiling H_2O. Sol. in acids. (Gibbs, Am. Ch. J. **15.** 560.)

$[Co(NH_3)_5(OH_2)]_2(SO_4)_3$, $Ce(SO_4)_2+2\frac{1}{2}H_2O$. As above. (Gibbs.)

—— **sulphate chloraurate.**

Three modifications:

α. $Co(NH_3)_5(OH_2)(SO_4)Cl$, $AuCl_3$. Ppt. (Jörgensen.)

β. $Co(NH_3)_5(SO_4)$, $AuCl_3+2H_2O$. Sl. sol. in cold H_2O. (Gibbs.)

γ. As above. Can be recrystallised from hot H_2O.

—— **sulphate chloroplatinate,**
$2Co(NH_3)_5(OH_2)(SO_4)Cl_2$, $PtCl_4$.

Three modifications, all difficultly sol. in hot or cold H_2O. (Jörgensen.)

—— **sulphite,** $[Co(NH_3)_5(OH_2)]_2(SO_3)_3+H_2O$.

Sl. sol. in cold, decomp. by hot H_2O. (Gibbs.)

—— **cobaltic sulphite**
$[Co(NH_3)_5]_2(SO_3)_3$, $Co_2(SO_3)_3+9H_2O$.

Insol. in cold, decomp. by hot H_2O. (Künzel.)

Roseocobaltic octamine compounds.

See **Roseotetramine cobaltic compounds.**

Roseoiridium compounds.

See **Iridoaquopentamine compounds.**

Roseorhodium bromide, $Rh(NH_3)_5(OH_2)Br_3$.

Sol. in cold H_2O. (Jörgensen, J. pr. (2) **34.** 394.)

Roseorhodium cobalticyanide, $Rh(NH_3)_5(OH_2)Co(CN)_6$.

Scarcely sol. in H_2O.

—— **iodosulphate,** $Rh(NH_3)_5(OH_2)I(SO_4)$.

Very sl. sol. in H_2O; easily sol. in NH_4OH + Aq. (Jörgensen.)

—— **nitrate,** $Rh(NH_3)_5(OH_2)(NO_3)_3$.

Moderately sol. in cold H_2O. (Jörgensen.)

$Rh(NH_3)_5(OH_2)(NO_3)_3$, HNO_3. Decomp. by H_2O or alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— **nitrate chloroplatinate,** $[Rh(NH_3)_5(OH_2)(NO_3)]_2PtCl_6+2H_2O$.

Ppt. (Jörgensen.)

—— *ortho***phosphate,** $[Rh(NH_3)_5(OH_2)]_2(HPO_4)_3+4H_2O$.

Very sl. sol. in H_2O.

—— **sodium** *pyro***phosphate,** $[Rh(NH_3)_5(OH_2)]_2NaP_2O_7+23H_2O$.

Ppt. Very sl. sol. in cold H_2O. Easily sol. in very dil. acids.

—— **sulphate,** $[Rh(NH_3)_5(OH_2)]_2(SO_4)_3+3H_2O$.

Very sl. sol. in cold, much more in hot H_2O.

—— **sulphate chloroplatinate,** $Rh(NH_3)_5(OH_2)(SO_4)PtCl_6$.

Ppt. Nearly insol. in H_2O or alcohol.

Roseotetramine cobaltic bromide, $Co(NH_3)_4(OH_2)_2Br_3$.

Sol. in H_2O; insol. in HBr + Aq. Nearly insol. in alcohol. (Jörgensen, Z. anorg. **2.** 295.)

—— —— **chloride,** $Co(NH_3)_4(OH_2)_2Cl_3$.

Easily sol. in H_2O; insol. in conc. HCl + Aq; sol. in sat. $HgCl_2$ + Aq. (Jörgensen.)

—— —— **cobalticyanide,** $Co(NH_3)_4(OH_2)_2Co(CN)_6$.

(Jörgensen.)

—— —— **oxalate sulphate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2C_2O_4$.

Ppt. (Jörgensen.)

—— —— *pyro***phosphate,** $[Co(NH_3)_4(OH_2)_2]_4(P_2O_7)_3+6H_2O$.

Nearly insol. in H_2O, but easily sol. in very dil. acids + Aq. (Jörgensen.)

—— —— **sulphate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_3+3H_2O$.

Sol. in about 35 pts. H_2O, and more easily by addition of dil. HCl or H_2SO_4 + Aq. (Jörgensen.)

—— —— **sulphate bromaurate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2AuBr_4$.

Sl. sol. in cold H_2O; insol. in alcohol. (Jörgensen.)

—— —— **sulphate chloroplatinate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2PtCl_6$.

As the bromaurate. (Jörgensen.)

Rubidium, Rb_2.

Decomp. H_2O with violence. Insol. in hydrocarbons. Sol. in liquid NH_3. (Seely, C. N. **23.** 169.)

Rubidium bromide, RbBr.

100 pts. H_2O dissolve 98 pts. at 5°; 104·8 pts. at 16°. (Reissig, A. **127.** 33.)

Rubidium *tri***bromide,** $RbBr_3$.

Very sol. in H_2O; decomp. by alcohol and ether. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

Rubidium tellurium bromide.

See **Bromotellurate, rubidium.**

Rubidium stannic bromide.

See **Bromostannate, rubidium.**

Rubidium bromochloride, $RbBr_2Cl$.

Easily decomp., even by H_2O. (Wells and Wheeler.)

$RbBrCl_2$. Sol. in H_2O; decomp. by alcohol and ether. (Wells and Wheeler.)

Rubidium bromochloroiodide, RbBrClI.

Sol. in H_2O and alcohol. Decomp. by ether. (Wells and Wheeler.)

Rubidium bromoiodide, $RbBr_2I$.

Very sol. in H_2O. Sat. solution contains about 44 % $RbBr_2I$, and sp. gr. = 3·84. (Wells and Wheeler.)

Rubidium chloride, RbCl.

100 pts. H_2O dissolve 76·38 pts. at 1°; 82·89 pts. at 7°. (Bunsen.)

Sp. gr. of RbCl + Aq containing in 100 pts. H_2O:

13·14	25·88	33·13	pts. RbCl.
1·1066	1·2156	1·2675	sp. gr.

(Tammann, W. Ann. **24.** 1885.)

Sol. in alcohol.

Rubidium tellurium chloride.

See **Chlorotellurate, rubidium.**

Rubidium thallic chloride, 3RbCl, $TlCl_3$.

Crystallises from HCl solution. (Neumann, A. **244.** 348.)

$+2H_2O$. Efflorescent in dry air. Sol. in 7·5 pts. H_2O at 18°, and 1·6 pts. at 100°. (Godeffroy, Zeitschr. d. allgem. österr. Apothekerv. **1880.** No. 9.)

Rubidium stannic chloride.

See **Chlorostannate, rubidium.**

Rubidium zinc chloride, 2RbCl, $ZnCl_2$.

Easily sol. in H_2O and HCl + Aq. (Godeffroy, B. **8.** 9.)

Rubidium chloroiodide, $RbCl_2I$.

Properties are similar to those of RbBrClI. (Wells.)

$RbCl_4I$. Sol. in alcohol, not attacked by ether. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Rubidium uranyl fluoride, 4RbF, $UO_2F_2+6H_2O$.

(Ditte, C. R. **91.** 115.)

Rubidium hydroxide, RbOH.

Deliquescent, and very sol. in H_2O. Sol. in alcohol. (Bunsen.)

Rubidium iodide, RbI.

100 pts. H_2O dissolve 137·5 pts. at 6·9°; 152 pts. at 17·4°. (Reissig, A. **127.** 33.)

Rubidium *tri*iodide, RbI_3.

Very sol. in H_2O. Sol. in about ¼ pt. H_2O at 20°; sol. in alcohol. Decomp. by ether. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

Rubidium silver iodide, 2RbI, AgI.

Easily decomp. by H_2O. (Wells and Wheeler, Sill. Am. J. **144.** 155.)

Rubidium tellurium iodide.

See **Iodotellurate, rubidium.**

Ruthenic acid.

Barium ruthenate, $BaRuO_4+H_2O$.

Ppt. (Debray and Joly, C. R. **106.** 1494.)

Calcium ruthenate, $CaRuO_4$.

Ppt.

Magnesium ruthenate, $MgRuO_4$.

Ppt.

Potassium ruthenate, $K_2RuO_4+H_2O$.

Very sol. in H_2O.

*Per*ruthenic acid.

Potassium *per*ruthenate, $KRuO_4$.

Sl. sol. in H_2O. (Debray and Joly, C.R. **106.** 1494.)

Sodium *per*ruthenate, $NaRuO_4+H_2O$.

Sl. sol. in H_2O.

Ruthenium, Ru.

Not attacked by acids, except aqua regia, which dissolves it only very slightly. (Claus, Pogg. **65.** 218.)

Ruthenium ammonium comps.

See **Rutheno*di*amine comps**, etc.

Ruthenium *di*chloride, $RuCl_2$.

Insol. in acids, even in aqua regia. Sl. attacked by acids. Traces are dissolved by boiling with conc. KOH+Aq.

$+xH_2O$. Known only in aqueous solution. (Claus, A. **59.** 238.)

Ruthenium *tri*chloride, $RuCl_3$.

Deliquescent. Sol. in H_2O and alcohol, but solution is decomp. by heating into Ru_2O_3 and HCl. (Claus.)

Pure $RuCl_3$ is insol. in cold H_2O, mineral, or organic acids. Slowly decomp. by boiling H_2O. Insol. in CCl_4, CS_2, $CHCl_3$, PCl_3, or ether. Slowly sol. in hot absolute alcohol, but decomp. into $Ru(OH)Cl_2$ by 95% alcohol. (Joly, C. R. **114.** 292.)

See also **Ruthenium nitrosochloride.**

Ruthenium *tetra*chloride, $RuCl_4$.

Sol. in H_2O and alcohol. (Claus.)

Ruthenium *sesqui*chloride *with* MCl.

See **Chlororuthenite, M.**

Ruthenium *tetra*chloride *with* MCl.

See **Chlororuthenate, M.**

Ruthenium *sesqui*hydroxide, $Ru_2O_6H_6$.

Sol. in acids; insol. in alkalies. Less sol. in NH_4OH+Aq than any other oxide of the Pt metals. (Claus.)

Ruthenium *di*hydroxide, $RuO_4H_4+3H_2O$.

Sol. in acids and alkalies. (Claus, A. **59.** 237.)

Contains NO. (Joly, C. R. **107.** 994.)

Ruthenium *sesqui*iodide, Ru_2I_6 (?).

Ppt. (Claus.)

Ruthenium nitrosochloride, $RuCl_3(NO)+H_2O$, and $5H_2O$.

Slowly sol. in cold, easily in hot H_2O (Joly, C. R. **108.** 855.)

Ruthenium nitroso*sesqui*oxide, $Ru_2O_3(NO)_2+2H_2O$.

Ppt. (Joly, C. R. **108.** 854.)

Ruthenium *mon*oxide, RuO.

Insol. in acids. (Claus, A. **59.** 236.)

Ruthenium *sesqui*oxide, Ru_2O_3.

Insol. in acids. Mixture of Ru and RuO_2. (Debray and Joly, C. R. **106.** 1494.)

See **Ruthenium nitroso*sesqui*oxide.**

Ruthenium *di*oxide, RuO_2.

Insol. in acids. (Debray and Joly.)

Ruthenium *tri*oxide, RuO_3.

"Ruthenic acid." Known only in its salts.

Ruthenium *tet*roxide, RuO_4.

Rather difficultly and slowly sol. in H_2O. (Claus.)

Decomp. in aqueous solution into $Ru_2O_5+2H_2O$. (Debray and Joly.)

Ruthenium *pent*oxide, Ru_2O_5.

(Debray and Joly, C. R. **106.** 1494.)

$+2H_2O$. Ppt. (Debray and Joly.)

Ruthenium *hept*oxide, Ru_2O_7.

"*Per*ruthenic acid." Known only in its salts.

Ruthenium oxide, Ru_4O_9.

(Debray and Joly.)

Ruthenium oxychloride, $Ru(OH)Cl_2$.

Very sol. in H_2O, but decomp. by an excess. (Joly, C. R. **114.** 293.)

Ruthenium sulphides.

Not isolated in a pure state.

Rutheno*mon*amine hydroxide, $Ru(OH)_2(NH_3)_2+4H_2O$.

See **Ruthenosamine hydroxide.**

Rutheno*di*amine carbonate, $Ru(N_2H_6)_2CO_3+5H_2O$.

Easily sol. in H_2O. Insol. in alcohol. (Claus.)

Ruthenodiamine chloride, $Ru(N_2H_6Cl)_2+3H_2O$.

Not very sol. in cold, easily sol. in hot H_2O. Insol. in alcohol.

See **Ruthenonitroso*di*amine comps.**

—— **mercuric chloride,** $Ru(N_2H_6Cl)_2$, $HgCl_2$.

Nearly insol. in cold, sol. in hot H_2O. (Gibbs, Sill. Am. J. (2) **34.** 350.)

—— **chloroplatinate,** $Ru(N_2H_6Cl)_2$, $PtCl_4$.

Sl. sol. in H_2O. (Claus.)

—— **hydroxide,** $[Ru(N_2H_6OH)_2$.

Known only in aqueous solution.

—— **nitrate,** $Ru(N_2H_6NO_3)_2+2H_2O$.

Somewhat difficultly sol. in cold, easily in hot H_2O. Insol. in alcohol.

—— **sulphate,** $Ru(N_2H_6)_2SO_4+4H_2O$.

Moderately sol. in H_2O. Insol. in alcohol. (Claus.)

Ruthenocyanhydric acid, $H_4Ru(CN)_6$.

Easily sol. in H_2O and alcohol. Less sol. in ether. (Claus, J. B. **1855.** 444.)

Potassium ruthenocyanide, $K_4Ru(CN)_6+3H_2O$.

Sl. efflorescent. Very sol. in H_2O; sl. sol. in dil. alcohol. (Claus.)

Ruthenonitroso*di*amine bromide, $Ru(NO)(NH_3)_4Br_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)

$Ru(NO)OH(NH_3)_4Br_2$. Less sol. than corresponding chloride. (Joly, C. R. **108.** 300.)

—— **chloride,** $Ru(NO)(NH_3)_4Cl_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)

$Ru(NO)OH(NH_3)_4Cl_2$. Sol. in H_2O. (Joly, C. R. **108.** 1300.)

$Ru(NO)(NH_3)_4Cl_3+2H_2O=$
$Ru(NO)(OH)(NH_3)_4Cl_2$, $HCl+H_2O$ (?). Very sol. in H_2O. (Joly, C. R. **111.** 969.)

—— **chloroplatinate,** $Ru(NO)OH(NH_3)_4PtCl_6$.

Scarcely sol. in boiling H_2O. (Joly, C. R. **108.** 1300.)

$Ru(NO)(NH_3)_4Cl_3$, $PtCl_4$. Ppt. (Joly, C. R. **111.** 969.)

—— **iodide,** $Ru(NO)(NH_3)_4I_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)

$Ru(NO)OH(NH_3)_4I_2$. Less sol. than the corresponding bromide. (Joly, C. R. **108.** 1300.)

—— **nitrate,** $Ru(NO)(NH_3)_4(NO_3)_3$.

More sol. in H_2O than
$Ru(NO)(OH)(NH_3)_4(NO_3)_2$. (Joly, C. R. **111.** 969.)

$Ru(NO)OH(NH_3)_4(NO_3)_2$. Sl. sol. in cold H_2O; insol. in conc. HNO_3+Aq. (Joly, C. R. **108.** 1300.)

—— **sulphate,** $[Ru(NO)(NH_3)_4]_2(SO_4)_3+10H_2O$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)

$[Ru(NO)(NH_3)_4]_4(SO_4)_6$, $H_2SO_4+H_2O$. Decomp. by cold H_2O. (Joly.)

$Ru(NO)(OH)_4(NH_3)_4SO_4+H_2O$. Most sol. in H_2O of this class of salts. (Joly, C. R. **108.** 1300.)

Ruthenonitrous acid.

Potassium ruthenonitrite, $K_6Ru_2(NO_2)_{12}=6KNO_2$, $Ru_2(NO_2)$.

Easily sol. in H_2O, alcohol, or ether. (Gibbs, Sill. Am. J. (2) **34.** 344.)

Sl. sol. in H_2O. Easily sol. in KNO_2+Aq. (Claus.)

$K_4Ru_2(NO_2)_{10}=Ru_2O_2(N_2O_3)_3$, $4KNO_2$. Very sol. in H_2O. (Joly and Vèzes, C. R. **109.** 667.)

$K_8Ru_2(NO_2)_{14}=Ru_2O_2(N_2O_3)_2$, $8KNO_2$. Sl. sol. in H_2O. Sol. in cold dil. acids. (Joly and Vèzes.)

Ruthenosamine hydroxide, $Ru(NH_3OH)_2+4H_2O$ (?).

Very deliquescent, and sol. in H_2O. (Claus.)

Samarium, Sm.

The element has not been isolated.

Samarium bromide, $SmBr_3+6H_2O$.

Very deliquescent. (Cleve.)

Samarium chloride, $SmCl_3+3H_2O$.

Deliquescent.

Samarium fluoride, $SmF_3+\frac{1}{2}H_2O$.

Precipitate. Insol. in H_2O and dil. acids. (Cleve.)

Samarium hydroxide, $Sm_2(OH)_6$.

Insol. in alkalies; easily sol. in acids, and decomposes ammonium salts. (Cleve, C. N. **51.** 145.)

Samarium oxide, Sm_2O_3.

Easily sol. in acids. (Cleve, C. N. **51.** 145.)

Samarium *per*oxide, Sm_4O_9.

Precipitate. (Cleve.)

Samarium oxychloride, $Sm_2O_2Cl_2$.

(Cleve, C. N. **51.** 145.)

Scandium, Sc.

Element has not been isolated.

Scandium hydroxide.

Easily sol. in conc. HNO_3 or $HCl+Aq$.

Scandium oxide, Sc_2O_3.

Easily sol. by boiling with conc. HNO_3 or $HCl+Aq$.

Selenantimonic acid.

Sodium selenantimonate, $Na_3SbSe_4+9H_2O$.

Sol. in 2 pts. cold H_2O. Insol. in alcohol. (Hofacker, A. **107.** 6.)

Selenic acid, H_2SeO_4.

Very sol. in H_2O with evolution of heat.

If aqueous solution is evaporated at temp. of 165°, acid has 2·524 sp. gr; at temp. of 267°, acid has 2·60 sp. gr.; at temp. of 285°, acid has 2·625 sp. gr. Decomp. to H_2SeO_3 at higher temp. (Mitscherlich, Pogg. **9.** 623.)

By evaporation at 265°, acid of 2·609 sp. gr. containing 95 % H_2SeO_4 is obtained. If brought at same temp. in vacuo over H_2SO_4, acid of 2·627 sp. gr. with 97·5 % H_2SeO_4 is obtained. (Fabian, A. Suppl. **1.** 243.)

Decomp. by alcohol.

Sol. in conc. or fuming H_2SO_4.

$+H_2O$. (Cameron and Macallan, C. N. **59.** 232.)

$+2H_2O$, and $+6H_2O$ (?). (C. and M.)

Sp. gr. of H_2SeO_4+Aq.

% H_2SeO_4	Sp. gr.	% H_2SeO_4	Sp. gr.
99·73	2·6083	90·0	2·3848
99·50	2·6051	89·0	2·3568
99·00	2·5975	88·0	2·3291
98·5	2·5863	87·0	2·3061
98·0	2·5767	86·0	2·2795
97·5	2·5695	85·0	2·5558
97·0	2·5601	84·0	2·2258
96·0	2·5388	83·0	2·1946
95·0	2·5163	82·0	2·1757
94·0	2·4925	81·0	2·1479
93·0	2·4596	80·0	2·1216
92·0	2·4322	79·0	2·0922
91·0	2·4081	73·50	1·9675

(Cameron and Macallan, Lond. R. Soc. Proc. **46**. 13.)

Selenates.

All the neutral and acid salts of H_2SeO_4 are sol. in H_2O, except $BaSeO_4$, $SrSeO_4$, $CaSeO_4$, and $PbSeO_4$, which are nearly or quite insol. in H_2O or HNO_3+Aq.

Aluminum selenate, $Al_2(SeO_4)_3$.

Resembles in every way aluminum sulphate. (Berzelius.)

Aluminum ammonium selenate, $Al_2(NH_4)_2(SeO_4)_4+24H_2O$.

More sol. in H_2O than the corresponding sulphate. (Wohlwill, A. **114.** 191.)

Aluminum cæsium selenate, $Al_2Cs_2(SeO_4)_4+24H_2O$.

(Peterson, B. **9.** 1563.)

Much more sol. in H_2O than the corresponding sulphate. (Fabre, C. R. **105.** 114.)

Aluminum potassium selenate, $Al_2K_2(SeO_4)_4+24H_2O$.

More sol. in H_2O than common alum. (Weber, Pogg. **108.** 615.)

Aluminum rubidium selenate, $Al_2Rb_2(SeO_4)_4+24H_2O$.

(Peterson, B. **9.** 1563.)

Much more sol. in H_2O than the corresponding sulphate. (Fabre, C. R. **105.** 114.)

Aluminum sodium selenate, $Al_2Na_2(SeO_4)_4+24H_2O$.

Sl. efflorescent. Very sol. in H_2O. (Wohlwill, A. **114.** 191.)

Aluminum thallium sulphate, $Al_2Tl_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Aluminum selenate potassium sulphate, $Al_2(SeO_4)_3$, $K_2SO_4+24H_2O$.

Sol. in H_2O. (v. Gerichten, A. **168.** 222.)

Ammonium selenate, $(NH_4)_2SeO_4$.

Easily sol. in H_2O.

Ammonium hydrogen selenate, NH_4HSeO_4.

Sol. in H_2O. (Topsoë.)

Ammonium cadmium selenate, $(NH_4)_2SeO_4$, $CdSeO_4+2H_2O$.

Sol. in H_2O. (Topsoë, W. A. B. **66, 2.** 2.)

$+6H_2O$. Efflorescent. Very easily sol. in H_2O. (Topsoë.)

Ammonium cerous selenate, $(NH_4)_2Ce_2(SeO_4)_4+9H_2O$.

Easily sol. in H_2O. (Jolin.)

Ammonium chromium selenate, $(NH_4)_2Cr_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Ammonium cobaltous selenate, $(NH_4)_2SeO_4$, $CoSeO_4+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Ammonium cupric selenate, $(NH_4)_2SeO_4$, $CuSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Ammonium didymium selenate, $(NH_4)_2SeO_4$, $Di_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve.)

$+10H_2O$. (Cleve, Bull. Soc. (2) **43.** 363.)

Ammodium erbium selenate, $(NH_4)_2SeO_4$, $Er_2(SeO_4)_3+4H_2O$.

Easily sol. in H_2O. (Cleve.)

Ammonium ferrous selenate, $(NH_4)_2Fe(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+2H_2O$.

Ammonium lanthanum selenate, $(NH_4)_2SeO$, $La_2(SeO_4)_3+9H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium magnesium selenate, $(NH_4)_2Mg(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Ammonium manganous selenate, $(NH_4)_2SeO_4$, $MnSeO_4+6H_2O$.

Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Ammonium nickel selenate, $(NH_4)_2SeO_4$, $NiSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Ammonium samarium selenate, $(NH_4)_2SeO_4$, $Sm_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve.)

Ammonium uranyl selenate, $(NH_4)_2SeO_4$, $(UO_2)SeO_4+2H_2O$.

Easily sol. in H_2O. (Sendtner.)

Ammonium yttrium selenate, $(NH_4)_2SeO_4$, $Y_2(SeO_4)_3+6HO$.

Very sol. in H_2O. (Cleve.)

Ammonium zinc selenate, $(NH_4)_2SeO_4$, $ZnSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Antimony selenate.

Insol. in H_2O. Not very sol. in acids. Sol. in H_2SeO_4. (Cameron and Macallan.)

Barium selenate, $BaSeO_4$.

Somewhat more sol. in H_2O and dil. acids than $BaSO_4$. (Rose.) 100 ccm. H_2O dissolve 11·8 mg. in the cold, and 13·8 mg. at 100°. (Petersson, Z. anal. **12.** 287.)

Not decomp. by H_2SO_4. Insol. in HNO_3+Aq (Berzelius), but decomp. by solution of alkali carbonates at ordinary temp.

Very slowly decomp. by HCl+Aq. (Rose, Pogg. **95.** 426.)

Bismuth selenate.

Insol. in, and not decomp. by cold or hot H_2O. (Cameron and Macallan.)

Cæsium selenate, Cs_2SeO_4.

Sol. in H_2O. (Petersson, B. **9.** 1561.)

Cæsium chromic selenate, $Cs_2Cr_2(SeO_4)_4 + 24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Cæsium cobaltous selenate, $Cs_2Co(SeO_4)_2 + 6H_2O$.

Sol. in H_2O. (Topsoë.)

Cadmium selenate, $CdSeO_4 + 2H_2O$.

Very sol. in H_2O. (v. Hauer, W. A. B. **39.** 299.)

Cadmium potassium selenate, $CdSeO_4, K_2SO_4 + 2H_2O$.

Sol. in H_2O; can be recrystallised without decomp. (v. Hauer, W. A. B. **54.** 209.)

Calcium selenate, $CaSeO_4 + 2H_2O$.

Less sol. in hot than in cold H_2O. (v. Hauer, J. pr. **80.** 214.)

Cerous selenate, $Ce_2(SO_4)_3 + 6H_2O$, $9H_2O$, or $12H_2O$.

More sol. in cold than hot H_2O. (Jolin.)

Cerous potassium selenate, $Ce_2(SeO_4)_3, 5K_2SeO_4$.

More sol. in H_2O than the corresponding sulphate. (Jolin.)

Cerous sodium selenate, $Ce_2(SeO_4)_3, Na_2SeO_4 + 5H_2O$.

Quite sol. in H_2O. (Jolin.)

Chromic potassium selenate, $Cr_2K_2(SeO_4)_4 + 24H_2O$.

Resembles the sulphate in every particular.

Chromic rubidium selenate, $Cr_2Rb_2(SeO_4)_4 + 24H_2O$.

Sol. in H_2O.

Chromic sodium selenate, $Cr_2Na_2(SeO_4)_4 + 24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Chromic thallous selenate, $Cr_2Tl_2(SeO_4)_4 + 24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Chromic selenate potassium sulphate, $Cr_2(SeO_4)_3, K_2SO_4 + 24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Cobaltous selenate, basic, $4CoO, 3SeO_3 + H_2O$.

Insol. in H_2O; sol. in acids. (Bogdan, Bull. Soc. (3) **9.** 586.)

Cobaltous selenate, $CoSeO_4 + 5H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+6H_2O$. Easily sol. in H_2O. (Topsoë.)

$+7H_2O$. Efflorescent. Extremely sol. in H_2O. (Topsoë.)

Cobaltous potassium selenate, $CoSeO_4, K_2SeO + 6H_2O$.

More sol. in H_2O than corresponding sulphate. (v. Hauer, W. A. B. **39.** 837.)

Cobaltous rubidium selenate, $CoRb_2(SeO_4)_2 + 6H_2O$.

Sol. in H_2O. (Topsoë.)

Cobaltous thallous selenate, $CoTl_2(SeO_4)_2 + 6H_2O$.

Sol. in H_2O. (Topsoë.)

Cupric selenate, basic, $3CuO, 2SeO_3 + 4H_2O$.

Insol. in H_2O; sol. in acids. (Bogdan, Bull. Soc. (3) **9.** 588.)

Cupric selenate, $CuSeO_4 + 5H_2O$.

Easily sol. in H_2O. (Topsoë.)

Cupric magnesium selenate, $CuMg_3(SeO_4)_4 + 28H_2O$.

Sol. in H_2O. (Wohlwill.)

Cupric nickel selenate, $CuSeO_4, NiSeO_4 + 14H_2O$.

Sol. in H_2O. (Wohlwill.)

Cupric potassium selenate, $CuSeO_4, K_2SeO_4 + 6H_2O$.

Sl. sol. in H_2O. (Topsoë.)

Cupric zinc selenate, $CuZn_3(SeO_4)_4 + 28H_2O$.

Sol. in H_2O. (Wohlwill.)

Cupric selenate ferrous sulphate, $2CuSeO_4, 3FeSO_4 + 35H_2O$.

Sol. in H_2O. (Wohlwill.)

Cupric selenate magnesium sulphate, $CuSeO_4, 3MgSO_4 + 28H_2O$.

Sol. in H_2O. (Wohlwill.)

Cupric selenate zinc sulphate, $CuSeO_4, 3ZnSO_4 + 28H_2O$.

Sol. in H_2O. (Wohlwill.)

Didymium selenate, $Di_2(SeO_4)_3 + 5H_2O$, or $6H_2O$.

Sol. in H_2O.

$+8H_2O$. Easily sol. in H_2O. (Cleve.)

$+10H_2O$. Sol. in H_2O. (Cleve.)

Didymium potassium selenate, $Di_2(SeO_4)_3, K_2SeO_4 + 9H_2O$.

Not deliquescent. Easily sol. in H_2O. (Cleve.)

Didymium sodium selenate, $Di_2(SeO_4)_3$, $Na_2SeO_4+4H_2O$.

Easily sol. in H_2O. (Cleve.)

Erbium selenate, $Er_2(SeO_4)_3+8H_2O$, and $9H_2O$.

Easily sol. in H_2O. (Topsoë.)

Erbium potassium selenate, $Er_2(SeO_4)_3$, $K_2SeO_4+8H_2O$.

Easily sol. in H_2O. (Cleve.)

Glucinum selenate, $GlSeO_4+4H_2O$.

Very sol. in H_2O. (Atterberg.)

Ferrous selenate, $FeSeO_4+5H_2O$.

Sol. in H_2O. (Wohlwill, A. **114.** 169.)

$+7H_2O$. Efflorescent, and sol. in H_2O. (Topsoë.)

Ferrous potassium selenate, $FeSeO_4$, $K_2SeO_4+6H_2O$.

Easily sol. in H_2O. Solution decomp. somewhat on standing. (Topsoë.)

Ferric selenate potassium sulphate, $Fe_2(SeO_4)_3$, $K_2SO_4+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Lanthanum selenate, $La_2(SeO_4)_3+6H_2O$, or $10H_2O$.

Easily sol. in cold H_2O. (Cleve.)

$+12H_2O$. (Frerichs and Smith, A. **191.** 355.)

Lanthanum potassium selenate, $La_2(SeO_4)_3$, $K_2SeO_4+9H_2O$.

Quite sol. in H_2O. (Cleve.)

Lanthanum sodium selenate, $La_2(SeO_4)_3$, $Na_2SeO_4+4H_2O$.

Easily sol. in H_2O. (Cleve.)

Lead selenate, basic, $2PbO$, SeO_3.

Decomp. by acids with separation of $PbSeO_4$.

Lead selenate, $PbSeO_4$.

Insol. in H_2O or HNO_3+Aq. (Schafarik, W. A. B. **47.** 256.)

Min. *Kerstenite.*

Lithium selenate, $Li_2SeO_4+H_2O$.

Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Magnesium selenate, $MgSeO_4+6H_2O$.

Solubility resembles closely that of $MgSO_4$. (Topsoë.)

Magnesium potassium selenate, $MgK_2(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Manganous selenate, $MnSeO_4+2H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+5H_2O$. Easily sol. in H_2O. Solution decomp. on warming or standing. (Topsoë.)

Manganous potassium selenate, K_2SeO_4, $MnSeO_4$.

Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Mercurous selenate, $6Hg_2O$, $5SeO_3$.

Very sl. sol. in H_2O. Sl. attacked by boiling HNO_3. Insol. in $HCl+Aq$. (Köhler, Pogg. **89.** 146.)

Hg_2SeO_4. Very sl. sol. in H_2O; insol. in $HCl+Aq$. (Cameron and Davy, C. N. **44.** 63.)

Mercuric selenate, $HgSeO_4+H_2O$.

Decomp. by H_2O with formation of basic salt. (Köhler.)

Sol. in H_2SeO_4, H_2SO_4, HNO_3, or $HCl+Aq$, but decomp. by H_2O to $2HgO$, $HgSeO_4$. (Cameron and Davy, C. N. **44.** 63.)

Mercuric selenate, basic, $6HgO$, $2SeO_3+H_2O$.

Insol. in H_2O, or cold HNO_3+Aq. Sol. in hot HNO_3 or $HCl+Aq$. (Köhler.)

$HgSeO_4$, $2HgO$. Sol. in 10,330 pts. H_2O. (Cameron and Davy.)

Nickel selenate, $NiSeO_4+6H_2O$.

Very easily sol. in H_2O. (v. Hauer, W. A. B. **39.** 305.)

Nickel potassium selenate, $NiSeO_4$, $K_2SeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Nickel thallium selenate, $NiSeO_4$, $Tl_2SeO_4+6H_2O$.

Sol. in H_2O. (Petersson.)

Platinum selenate.

Sol. in boiling H_2O. (Cameron and Macallan, Lond. R. Soc. Proc. **46.** 13.)

Potassium selenate, K_2SeO_4.

Nearly equally sol. in cold and hot H_2O. (Mitscherlich, Pogg. **9.** 623.)

If solubility S = pts. anhydrous K_2SeO_4 in 100 pts. of solution, $S=52{\cdot}0+0{\cdot}0250t$ from $-20°$ to $+100°$. (Étard, C. R. **106.** 741.)

Potassium hydrogen selenate, $KHSeO_4$.

Sol. in H_2O.

Potassium samarium selenate, K_2SeO_4, $Sm_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 166.)

Potassium sodium selenate, $3K_2SeO_4$, Na_2SeO_4.

Sol. in H_2O. (Topsoë.)

Potassium uranyl selenate, K_2SeO_4, $(UO_2)SeO_4+2H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Sendtner.)

Potassium yttrium selenate, K_2SeO_4, $Y_2(SeO_4)_3+6H_2O$.

Very sol. in H_2O. (Cleve.)

Potassium zinc selenate, K_2SeO_4, $ZnSeO_4+2H_2O$.

Sol. in H_2O. (Topsoë.)

$+6H_2O$. Sol. in H_2O. (Topsoë.)

Potassium selenate aluminum sulphate, K_2SeO_4, $Al_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate chromic sulphate, K_2SeO_4, $Cr_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate ferric sulphate, K_2SeO_4, $Fe_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate manganous sulphate, K_2SeO_4, $MnSO_4+6H_2O$.

Sol. in H_2O. (v. Gerichten, A. **168.** 225.)

Potassium selenate manganic sulphate, K_2SeO_4, $Mn_2(SeO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Rubidium selenate, Rb_2SeO_4.

Sol. in H_2O. (Petersson.)

Samarium selenate, $Sm_2(SeO_4)_3+8H_2O$.

More sol. in H_2O than $Sm_2(SO_4)_3$.

$+12H_2O$. Efflorescent. (Cleve.)

Samarium potassium selenate, $SmK(SeO_4)_2+3H_2O$.

Sol. in H_2O. (Cleve.)

Silver selenate, Ag_2SeO_4.

As Ag_2SO_4. (Mitscherlich, Pogg. **12.** 138.)

Silver selenate ammonia, Ag_2SeO_4, $4NH_3$.

Easily sol. in H_2O or NH_4OH+Aq without decomp. (Mitscherlich, Pogg. **12.** 141.)

Sodium selenate, Na_2SeO_4.

Very sol. in H_2O, forming supersat. solutions. Cryst. also with $10H_2O$, which effloresce. Maximum point of solubility is at 33°. (Mitscherlich.)

Strontium selenate, $SrSeO_4$.

Insol. in H_2O or HNO_3+Aq; decomp. by long boiling with $HCl+Aq$.

Thallous selenate, Tl_2SeO_4.

Sl. sol. in cold, much more in hot H_2O. Insol. in alcohol and ether. (Kuhlmann.)

Thallous hydrogen selenate, $HTlSeO_4+3H_2O$.

(Oettinger.)

Thallous zinc selenate, Tl_2SeO_4, $ZnSeO_4+6H_2O$.

Easily sol. in H_2O, but less than the corresponding sulphate. (Werther, Bull. Soc. **1865.** 60.)

Thorium selenate, $Th(SeO_4)_4+9H_2O$.

100 pts. H_2O dissolve 0·498 pt. $Th(SeO_4)_4$ at 0°, and 1·972 pts. at 100°. (Cleve.)

Stannic selenate, basic, $SnO(SeO_4)+H_2O$.

Deliquescent. Sol. in H_2O. (Ditte, C. R. **104.** 231.)

Uranyl selenate, $(UO_2)SeO_4$, $H_2SeO_4+18H_2O$.

Very deliquescent.

$2(UO_2)SeO_4$, $H_2SeO_4+12H_2O$. Efflorescent. Sol. in H_2O. (Sendtner, A. **195.** 325.)

Yttrium selenate, $Y_2(SeO_4)_3$.

Anhydrous. Sol. in H_2O with hissing and evolution of heat. (Popp.)

$+8H_2O$. Easily sol. in H_2O. (Cleve.)

$+9H_2O$. Efflorescent.

Zinc selenate, $ZnSeO_4+5H_2O$.

Sol. in H_2O. (Topsoë.)

$+6H_2O$. Sol. in H_2O. (Topsoë.)

$+7H_2O$. Sol. in H_2O.

Selenious acid, H_2SeO_3.

Deliquescent in moist, efflorescent in dry air. Very sol. in cold, and in nearly every proportion in hot H_2O. Easily sol. in alcohol. (Berzelius.)

Selenites.

Alkali selenites are sol. in H_2O. The other neutral selenites are in sol. in H_2O, but sol. in HNO_3+Aq, Pb, and Ag salts slowly. The neutral salts are insol. in $HCl+Aq$. The acid salts of the heavy metals are sol. in H_2O.

Aluminum selenite, basic, $4Al_2O_3$, $9SeO_2+36H_2O$.

Precipitate. (Nilson, Upsala, **1875.**)

Aluminum selenite, $Al_2(SeO_3)_3$.

Precipitate. (Berzelius.)

$+7H_2O$. Sl. sol. in H_2O. (Nilson.) Sol. in H_2SeO_3+Aq.

$+3H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano, A. ch. (6) **17.** 289.)

Aluminum selenite, acid, Al_2O_3, $4SeO_2+3H_2O$.

(Boutzoureano.)

$2Al_2O_3$, $9SeO_2+12H_2O$. Sol. in H_2O. (Nilson.)

Al_2O_3, $6SeO_2$. Very sol. in H_2O. (Berzelius.)

$+5H_2O$. (Nilson.)

$+2H_2O$. (Boutzoureano.)

Ammonium selenite, $(NH_4)_2SeO_3$.

Deliquescent. Very sol. in H_2O.

Precipitated from aqueous solution by alcohol. Insol. in ether. (Muspratt, A. **70.** 275.)

Ammonium hydrogen selenite, NH_4HSeO_3.

Not deliquescent. Sol. in H_2O. (Berzelius.)

Ammonium *tri*hydrogen selenite, $NH_4H_3(SeO_3)_2$.

Deliquescent. (Berzelius.)

Ammonium uranyl selenite, $(NH_4)_2SeO_3$, $(UO_2)SeO_3$.

Completely insol. in H_2O. (Sendtner.)

Antimony selenite, $Sb_2(SeO_3)_3$, SeO_2.

(Nilson, Bull. Soc. (2) **23.** 494.)

Barium selenite, $BaSeO_3$.

Sl. sol. in H_2O. Sol. in H_2SeO_3+Aq. Sol. in acids. (Nilson.)

$+H_2O$. (Nilson.)

Barium *pyro*selenite, $BaSe_2O_5$.

Very sl. sol. in cold, more in warm H_2O. (Berzelius.)

Bismuth selenite, $Bi_2(SeO_3)_3$, H_2SeO_3.

(Nilson.)

$Bi_2(SeO_3)_3$. (Nilson.)

Cadmium selenite, $CdSeO_3$.

Insol. in H_2O. Sol. in H_2SeO_3+Aq. (Muspratt, Chem. Soc. **2.** 65.)

$2CdO$, $3SeO_2+H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano.)

$CdO, 2SeO_2$. Insol. in H_2O; sol. in acids. (B.)

Cadmium selenite ammonia, $CdSeO_3, NH_3$.
Insol. in cold or hot H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Calcium selenite, $CaSeO_3+\frac{4}{3}H_2O$.
Very sl. sol. in H_2O. (Berzelius.) More sol. in H_2SeO_3+Aq.
$+2H_2O$. (Nilson.)

Calcium hydrogen selenite, $CaH_2(SeO_3)_2+H_2O$.
Quite sol. in H_2O. (Nilson.)
$Ca_2H_2Se_4O_{11}$. Easily sol. in H_2O. (Nilson.)

Cerous selenite, basic, $2Ce_2O_3, 5SeO_2+30H_2O$.
Precipitate. (Nilson.)

Cerous selenite, $Ce_2(SeO_3)_3+3H_2O$.
Insol. in H_2O. Sol. in much selenious acid. (Jolin.)
$+12H_2O$. (Nilson.)

Cerous selenite, acid, $Ce_2O_3, 4SeO_2+5$, or 6 H_2O.
Insol. in H_2O, but sol. in selenious, and other acids. (Jolin.)
$Ce_2O_3, 6SeO_2+5H_2O$. Not decomp. by H_2O. (Nilson.)

Chromium selenite, basic, $4Cr_2O_3, 9SeO_2+64H_2O$.
Precipitate. (Nilson.)

Chromic selenite, $Cr_2(SeO_3)_3+3H_2O$.
(Boutzoureano.)
$+15H_2O$. (Nilson.)
Very sl. sol. or insol. in H_2O; sl. sol. in H_2SeO_3+Aq; sol. in hot conc. HCl+Aq. (Taquet, C. R. **96.** 107.)

Chromic selenite, acid, $Cr_2O_3, 4SeO_2+13H_2O$.
Slowly sol. in HCl+Aq. Insol. in H_2O. (Nilson.)
$Cr_2O_3, 5SeO_2+9H_2O$. Insol. in H_2O. (Nilson.)

Chromic *di*selenite.
Insol. in H_2O; sol. in acids. (Taquet, C. R. **97.** 1435.)

Cobaltous selenite, $CoSeO_3$.
Insol. in H_2O. (Berzelius.)
$+\frac{1}{3}H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano, A. ch. (6) **17.** 289.)

Cobaltous hydrogen selenite, $CoH_2(SeO_3)_2$.
Sol. in H_2O. (Berzelius.)
$+2H_2O$. Sol. in H_2O with decomp. (Boutzoureano.)

Cuprous selenite.
Insol. in H_2O. Sol. in NH_4OH+Aq. (Berzelius.)

Cupric selenite, basic, $2CuO, SeO_2$.
Insol. in H_2O; sol. in NH_4OH+Aq. (Boutzoureano.)
Sol. in acids.

Cupric selenite, $CuSeO_3+\frac{1}{2}H_2O$.
Insol. in H_2O or H_2SeO_3+Aq. (Berzelius.)
$+H_2O$, and $2H_2O$. (Boutzoureano.)

Cupric selenite, acid, $CuO, 2SeO_2+H_2O=CuH_2(SeO_3)_2$.
Insol. in H_2O. Sol. in acids. (Nilson.)
$+2H_2O$. As above. (Boutzoureano.)
$+4H_2O$. As above. (B.)

Cupric selenite ammonia, $CuSeO_3, NH_3+H_2O$.
Decomp. by H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Didymium selenite, basic, $3Di_2O_3, 8SeO_2+28H_2O$.
Precipitate. (Nilson.)
$+21H_2O$. Insol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 363.)

Didymium selenite, $Di_2(SeO_3)_3+6H_2O$.
Precipitate. (Smith.)

Didymium selenite, acid, $Di_2O_3, 4SeO_2+5H_2O$.
Precipitate. (Cleve.)
Composition is $Di_2(SeO_3)_3+6H_2O$. (Smith.)
$+9H_2O$. (Nilson.)
$2Di_2O_3, 9SeO_2+18H_2O$. (Nilson.)

Erbium selenite, $Er_2(SeO_3)_3+5H_2O$, and $9H_2O$.
Precipitate. (Nilson.)

Erbium hydrogen selenite, $Er_2H_2(SeO_3)_4+4H_2O$.
Decomp. by hot H_2O.

Glucinum selenite, basic, $5GlO, 2SeO_2+10H_2O$.
Precipitate. (Nilson.) According to Atterberg, is $7GlO, 3SeO_2+14H_2O$.
$2GlO, SeO_2+4H_2O$. (Atterberg, Bull. Soc. (2) **19.** 497.)
$3GlO, 2SeO_2+6H_2O$. Insol. in H_2O. (Atterberg.)

Glucinum selenite, $GlSeO_4+2H_2O$.
Sol. in little H_2O, decomp. by excess. (Nilson.)

Glucinum selenite, acid.
(*a*) $3GlO, 5SeO_2+3H_2O$; (*b*) $GlO, 2SeO_2+H_2O$; (*c*) $3GlO, 7SeO_2+5H_2O$; (*d*) $GlO, 3SeO_2+2H_2O$. All are very sl. sol. in cold or warm H_2O. *a*, *b*, and *c* are sol. in warm H_2O containing HCl; *d* is sol. only in boiling dil. HCl+Aq. (Nilson.)

Indium selenite, basic, $In_8Se_9O_{30}+64H_2O$.
(Nilson.)

Indium selenite, $In_2(SO_3)_3+6H_2O$.
Sl. sol. in H_2O. (Nilson.)

Indium hydrogen selenite, $In_2(SeO_3)_3, 3H_2SeO_3+4H_2O$.
Sol. in H_2O. (Nilson.)
$2In_2(SeO_3)_3, 3H_2SeO_3+12H_2O$. Sol. in H_2O. (Nilson.)

Ferrous selenite.
Ppt. Sol. in HCl+Aq with partial separation of Se. (Berzelius.)

Ferrous hydrogen selenite.
Sl. sol. in H_2O. (Berzelius.)

Ferric selenite, basic, $2Fe_2O_3, 3SeO_2+xH_2O$.
Insol. in H_2O. (Berzelius.)

Fe_2O_3, $2SeO_2$. Insol. in H_2O, easily sol. in acids. (Boutzoureano, A. ch. (6) **17.** 289.)

$3Fe_2O_3$, $8SeO_2+28H_2O$. Insol. in H_2O. (Nilson.)

Ferric selenite, $Fe_2(SeO_3)_3+4H_2O$.

Insol. in H_2O. (Muspratt, Chem. Soc. **2.** 52.)

$+H_2O$. Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

$+3H_2O$. Insol. in H_2O. (B.)

$+10H_2O$. Insol. in H_2O. (B.)

Ferric selenite, acid, Fe_2O_3, $6SeO_2+xH_2O$.

Insol. in H_2O. Sol. in $HCl+Aq$. (Berzelius.)

$+2H_2O$. (Boutzoureano, A. ch. (6) **17.** 289.)

Fe_2O_3, $4SeO_2+H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano.)

Lanthanum selenite, basic, $3La_2O_3$, $8SeO_2+28H_2O$.

Precipitate. (Nilson.)

Lanthanum selenite, $La_2(SeO_3)_3+9H_2O$, or $12H_2O$.

Insol. in H_2O. (Nilson.)

Lanthanum selenite, acid, $La_2H_4(SeO_3)_5+4H_2O$.

(Nilson.)

$La_2H_6(SeO_3)_6+2H_2O$. (Cleve.)

Lead selenite, $PbSeO_3$.

Scarcely sol. in H_2O, even when it contains H_2SeO_3. Sl. sol. in HNO_3+Aq. (Berzelius.)

Lithium selenite, $Li_2SeO_3+H_2O$.

Difficultly sol. in H_2O. (Nilson, Bull. Soc. (2) **21.** 253.)

Lithium hydrogen selenite, $LiHSO_3$.

Very sol. in H_2O. (Nilson.)

Lithium *tri*hydrogen selenite, $LiH_3(SeO_3)_2$.

Not deliquescent. Sol. in H_2O. (Nilson.)

Magnesium selenite, $MgSeO_3+2H_2O$.

Insol. in H_2O; sol. in dil. acids, especially if warm, also in H_2SeO_3+Aq. (Boutzoureano, A. ch. (6) **18.** 302.)

$+3H_2O$. Very sl. sol. in hot H_2O. (Berzelius.)

$+6H_2O$. As the $2H_2O$ salt. (Boutzoureano.)

$+7H_2O$. Sl. sol. in H_2O. Easily sol. in acetic, and mineral acids. (Hilger, Z. anal. **13.** 132.)

Magnesium hydrogen selenite, $MgH_2(SeO_3)_2+3H_2O$.

Very deliquescent. Easily sol. in H_2O. (Nilson.)

Insol. in alcohol. (Muspratt.)

MgO, $2SeO_2$. Insol. in H_2O; sol. in acids. (Boutzoureano.)

Magnesium *tetra*hydrogen selenite, $MgH_4(SeO_3)_3$, and $+3H_2O$.

Sol. in H_2O. (Nilson.)

Manganous selenite, $MnSeO_3+H_2O$.

Precipitate. (Nilson.)

$+2H_2O$. Insol. in H_2O. (Berzelius.)

Sol. in cold $HCl+Aq$. (Muspratt.)

$+\frac{1}{2}H_2O$. Insol. in H_2O; sol. in dil. acids. (Boutzoureano.)

Manganous selenite, acid, $MnSe_2O_5$.

Sol. in H_2O. (Berzelius; Nilson.)

MnO, $2SeO_2+H_2O=MnH_2(SeO_3)_2$. (Boutzoureano, A. ch. (6) **17.** 289.)

$+5H_2O$. Decomp. by H_2O to $MnSeO_3$. (Boutzoureano.)

Manganic selenite, basic, Mn_2O_3, $2SeO_2$.

Insol. in H_2O, cold H_2SO_4, or HNO_3+Aq; insol. in hot dil. H_2SO_4 or HNO_3+Aq. (Laugier, C. R. **104.** 1508.)

Sol. in warm $HCl+Aq$ with decomp.

Manganic selenite, $Mn_2(SeO_3)_3+5H_2O$.

(Laugier.)

Manganic selenite, acid, Mn_2O_3, $4SeO_2$.

Insol. in H_2O, cold H_2SO_4, and HNO_3+Aq. Insol. in dil. hot H_2SO_4, and HNO_3+Aq. Sol. in cold $HCl+Aq$; and in H_2SO_3+Aq with separation of Se. (Laugier, C. R. **104.** 1508.)

Mercurous selenite, basic, $3Hg_2O$, $2SeO_2+5H_2O$.

(Boutzoureano.)

Mercurous selenite, Hg_2SeO_3.

Insol. in H_2O or H_2SeO_3+Aq. Sol. in hot HNO_3+Aq. (Köhler, Pogg. **89.** 146.)

Sl. sol. in $HCl+Aq$, and $KOH+Aq$. (Berzelius.)

Mercurous selenite, acid, $3Hg_2O$, $4SeO_2$.

Insol. in H_2O or H_2SeO_3+Aq. Sl. sol. in boiling HNO_3+Aq. (Köhler.)

Mercuric selenite, basic, $7HgO$, $4SeO_2$.

Insol. in H_2O. Sl. sol. in HNO_3+Aq. Easily sol. in $HCl+Aq$. (Köhler, Pogg. **89.** 146.)

Mercuric selenite, Hg_2SeO_4.

Insol. in H_2O. (Berzelius.) Nearly insol. in HNO_3+Aq. Sol. in K_2SeO_3+Aq. (Divers, Chem. Soc. **49.** 585.)

$HgSeO_3$, H_2SeO_3. Easily sol. in H_2O; very sl. sol. in alcohol. (Berzelius.)

Nickel selenite, $NiSeO_3+H_2O$.

Insol. in H_2O; sol. in H_2SeO_3+Aq. (Muspratt, Chem. Soc. **2.** 52.)

$+\frac{1}{2}H_2O$. Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 28.)

Nickel selenite, acid.

Sol. in H_2O. (Berzelius.)

Potassium selenite, $K_2SeO_3+H_2O$.

Very deliquescent. Sol. in nearly all proportions in H_2O. Insol. in alcohol, which separates it as oil from aqueous solution. (Muspratt, Chem. Soc. **2.** 52.)

Potassium hydrogen selenite, $KHSeO_3$.

Very deliquescent. Very sl. sol. in alcohol. (Muspratt, Chem. Soc. **2.** 52.)

Potassium *tri*hydrogen selenite, $KH_3(SeO_3)_2$.

Very deliquescent. Pptd. from H_2O by alcohol. (Muspratt.)

Not deliquescent. (Nilson.)

Potassium uranyl selenite, K_2SeO_3, $(UO_2)SeO_3$.

Absolutely insol. in H_2O. (Sendtner.)

Samarium selenite, basic, $3Sm_2O_3$, $8SeO_2+7H_2O$.

Precipitate. (Cleve.)

Samarium selenite, acid, Sm_2O_3, $4SeO_2+5H_2O$.

Precipitate. (Cleve.)

Scandium selenite, $Sc_2(SeO_3)_3+H_2O$.

Insol. precipitate.

Scandium hydrogen selenite, $Sc_2(SeO_3)_3$, $3H_2SeO_3$.

Insol. in H_2O. Not attacked by cold dil. acids, but easily if warmed.

Silver selenite, Ag_2SeO_3.

Very sl. sol. in cold, somewhat more sol. in hot H_2O. Easily sol. in hot HNO_3+Aq, from which it is precipitated by H_2O. (Berzelius.)

Insol. in K_2SeO_3+Aq ; sl. sol. in dil HNO_3+Aq. (Divers, Chem. Soc. **49.** 585.)

Silver selenite ammonia, Ag_2SeO_3, NH_3.

Insol. in boiling H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Sodium selenite, Na_2SeO_3.

Very sol. in H_2O. Insol. in alcohol. (Berzelius.)

$+5H_2O$.

Sodium selenite, acid, $NaHSeO_3$.

Permanent. Sol. in H_2O.

$Na_4Se_3O_8$. Sol. in H_2O. (Sacc, A. ch. (3) **21.** 119.)

$NaH_3(SeO_3)_2$. Not deliquescent. Sol. in H_2O.

Strontium selenite, $SrSeO_3+7H_2O$.

Precipitate. Insol. in H_2O. Sol. in HNO_3+Aq. (Muspratt.)

Strontium hydrogen selenite, $SrH_2(SeO_3)_2$.

Easily sol. in hot or cold H_2O. (Nilson.)

Nearly insol. in hot or cold H_2O. (Berzelius.)

Thallous selenite, Tl_2SeO_3.

Easily sol. in H_2O. Insol. in alcohol and ether. (Kuhlmann, Bull. Soc. (2) **1.** 330.)

Thallous hydrogen selenite, $TlHSeO_3$.

More sol. in H_2O than the above comp. (Kuhlmann.)

Thorium selenite, $Th(SeO_3)_2+H_2O$, or $8H_2O$.

Insol. in H_2O ; easily sol. in HCl+Aq. (Nilson.)

Thorium selenite, acid, $2ThO_2$, $7SeO_2+16H_2O$.

ThO_2, $5SeO_2+8H_2O$. (Nilson.)

Stannic selenite.

Insol. in H_2O ; sol. in HCl+Aq, from which it is pptd. by H_2O. (Berzelius.)

Uranic selenite, U_2O_3, SeO_2.

Insol. in H_2O. (Boutzoureano.)

$+2H_2O$. (B.)

Uranic selenite, acid, $2U_2O_3$, $3SeO_2+7H_2O$.

Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Uranyl selenite, $(UO_2)SeO_3+2H_2O$.

Precipitate. (Nilson.)

Uranyl selenite, acid, $3UO_3$, $5SeO_2+7H_2O$, or $9H_2O$.

Insol. in H_2O.

UO_3, $2SeO_2+H_2O=(UO_2)H_2(SeO_3)_2$. Absolutely insol. in H_2O and H_2SeO_3+Aq. (Sendtner, A. **195.** 325.)

Ytterbium selenite, $Yb_2(SeO_3)_3$.

Insol. precipitate.

Ytterbium hydrogen selenite, $Yb_2H_2(SeO_3)_4+4H_2O$.

Insol. in H_2O.

Yttrium selenite, $Y_2(SeO_3)_3+12H_2O$.

Insol. in H_2O or H_2SeO_3+Aq. (Berzelius.)

Sol. in hot H_2SeO_3+Aq. (Nilson.)

Yttrium hydrogen selenite, $Y_2H_2(SeO_3)_4+3H_2O$.

Sl. sol. in H_2O. Easily sol. in HCl or HNO_3+Aq. (Cleve.)

Zinc selenite, $ZnSeO_3$.

Insol. in H_2O ; sol. in acids. (Boutzoureano, A. ch. (6) **18.** 289.)

$+2H_2O$. Insol. in H_2O. Sol. in H_2SeO_3, or HNO_3+Aq. (Muspratt, Chem. Soc. **2.** 52.)

Zinc hydrogen selenite, $ZnH_2(SeO_3)_2$.

Easily sol. in H_2O. (Berzelius.)

$+2H_2O$. Sol. in cold H_2O. (Boutzoureano.)

ZnO, $4SeO_2+3H_2O$. Easily sol. in H_2O. (Wöhler, A. **63.** 279.)

Zinc selenite ammonia, $ZnSeO_3$, NH_3.

Insol. in cold or hot H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Zirconium selenite, basic, $4ZrO_2$, $3SeO_2+18H_2O$.

Precipitate. Sl. sol. in HCl+Aq. (Nilson.)

Zirconium selenite, $Zr(SeO_3)_2$.

Absolutely insol. in H_2O ; difficultly sol. in boiling HCl+Aq. (Nilson.)

$+H_2O$. (Nilson.)

Selenium, Se.

Insol. in H_2O. Schultze (J. pr. (2) **32.** 390) has recently obtained a soluble colloidal modification which can be isolated by dialysis.

Insol. in HCl+Aq. Decomp. by HNO_3+Aq. Sol. in fuming H_2SO_4. (Schultz-Sellac, B. **4.** 113.)

1000 pts. CS_2 dissolve 1 pt. cryst. Se at boiling-point (46·6°), and 0·16 pt. at 0° (Mitscherlich, J. B. **1855.** 314). Solubility of Se in CS_2 is variable—1 pt. Se is sol. in 1376-2464-3746 pts. CS_2 at 20° (Rammelsberg, B. **7.** 669). Cryst. Se, which is sol. in CS_2, becomes insol. in CS_2 after heating to 110°, but after fusion is again sol. (Otto).

Four modifications.—(1) Amorphous red ; (2) crystalline red ; (3) granular gray ; (4) laminated. 1 and 2 are sol. in CS_2, 3 and 4 are insol. in CS_2. All forms are sol. in $SeCl_2$, from which crystallises a black modification insol. in CS_2. CCl_4 with trace of CS_2 dissolves red Se slightly, black Se not at all. $Se(C_2H_5)_2$ dissolves all modifications in small but apparently equal quantities. (Rathke, A. **152**. 181.)

Se_2Br_2 dissolves 22 % Se. (Schneider, Pogg. **128**. 327.)

Red Se is sol. in $(NH_4)_2SO_3$+Aq. (Uelsmann, A. **116**. 122.)

Sol. in alkali and Mg sulphites+Aq.

365 pts. K_2SO_3 dissolve 102 pts. Se.

360 pts. $MgSO_3$, $3H_2O$ dissolve 116 pts. Se.

Insol. in $BaSO_3$+Aq. (Rathke and Zschiesche, J. pr. **92**. 145.)

Sol. in KCN+Aq with formation of KSeCN.

100 pts. methylene iodide dissolve 1·3 pts. Se at 12°. (Retgers, Z. anorg. **3**. 343.)

Selenium *mono*bromide, Se_2Br_2.

Insol. in H_2O, but gradually decomp. thereby. Decomp. by absolute alcohol and benzene. Sol. in C_2H_5I, but soon decomposed. Miscible with CS_2; less sol. in $CHCl_3$ and C_2H_5Br. (Schneider, Pogg. **128**. 327.)

Selenium *tetra*bromide, $SeBr_4$.

Sol. in H_2O with decomp. Decomp. by alcohol. Sol. in HCl+Aq; sl. sol. in CS_2, $CHCl_3$, and C_2H_5Br. (Schneider, Pogg. **129**. 450.)

Decomp. by C_2H_5I.

Selenium bromo*tri*chloride, $SeCl_3Br$.

Insol. in CS_2. (Evans and Ramsay, Chem. Soc. **45**. 62.)

Selenium *tri*bromochloride, $SeClBr_3$.

See **Selenium chloro*tri*bromide.**

Selenium *mono*chloride, Se_2Cl_2.

Gradually decomp. by H_2O. Dissolves all modifications of selenium on heating (Rathke, A. **152**. 181). Insol. in conc. H_2SO_4; easily sol. in fuming H_2SO_4. Sol. in $CHCl_3$, C_6H_6, CCl_4. Gradually decomp. by H_2O, alcohol, and ether. (Divers and Shimosé, B. **17**. 862.) Sol. in CS_2. (Evans and Ramsay, Chem. Soc. **45**. 62.)

Selenium *tetra*chloride, $SeCl_4$.

Deliquescent on moist air. Decomp. with H_2O. (Berzelius, A. ch. **9**. 225.) Insol. in CS_2. Easily sol. in hot $POCl_3$, from which it crystallises on cooling. (Michaelis, Zeit. Chem. (2) **6**. 460.) Very sl. sol. in CS_2. (Evans and Ramsay, Chem. Soc. **45**. 62.)

Selenium *di*chlorobromide, $SeCl_2Br_2$.

(Evans and Ramsay, Chem. Soc. **45**. 62.)

Selenium chloro*tri*bromide, $SeClBr_3$.

Very sl. sol. in CS_2. (Evans and Ramsay.)

Selenium *tri*chlorobromide, $SeCl_3Br$.

See **Selenium bromo*tri*chloride.**

Selenium fluoride.

Sol. in conc. HF+Aq. Decomp. immediately by H_2O. (Knox.)

Selenium *mono*iodide, Se_2I_2.

Decomp. by H_2O. All solvents of iodine dissolve out that element. (Schneider, Pogg. **129**. 627.)

Selenium *tetra*iodide, SeI_4.

Slowly decomp. by much H_2O. Iodine is dissolved out by all solvents of that element. (Schneider, Pogg. **129**. 627.)

Selenium nitride.

See **Nitrogen selenide.**

Selenium *mon*oxide, SeO (?).

Sl. sol. in H_2O. (Berzelius.)

Does not exist. (Sacc.)

Selenium *di*oxide, SeO_2.

Deliquescent. Easily sol. in H_2O and alcohol. Sol. in glacial $HC_2H_3O_2$. (Hinsberg, A. **260**. 40.)

See **Selenious acid.**

Selenium *tri*oxide, SeO_3.

Not obtained in a pure state. (Cameron and Macallan.)

See **Selenic acid.**

Selenium *di*oxide hydrobromic acid, SeO_2, 4HBr.

Decomp. at 55°. (Ditte, A. ch. (5) **10**. 82.)

SeO_5, 5HBr. Decomp. at 65°. (Ditte, A. ch. (5) **10**. 82.)

Selenium *di*oxide hydrochloric acid, SeO_2, 2HCl.

Decomp. at 26°.

SeO_2, 4HCl. Decomp. at 0°. Sol. in H_2O without evolution of gas. (Ditte, A. ch. (5) **10**. 82.)

Selenium *di*oxide sulphur *tri*oxide, SeO_2, SO_3.

Decomp. violently by H_2O. (Weber, B. **19**. 3185.)

Composition may be $(SeO)SO_4$ (?).

Selenium oxy- compounds.

See **Selenyl compounds.**

Selenium *di*phosphide, P_2Se.

See **Phosphorus *mono*selenide.**

Selenium *tetra*phosphide, P_4Se.

See **Phosphorus *semi*selenide.**

Selenium *mono*sulphide, SeS.

Insol. in H_2O and ether. Sol. in CS_2. Decomp. by alcohol. (Ditte, C. R. **73**. 625, 660.)

Other compounds of Se and S are probably mixtures of the two elements.

Selenium *di*sulphide, SeS_2.

Compound of this formula is a mixture of SeS and S. (Ditte, C. R. **73**. 625, 660.)

Selenium sulphoxide, $SeSO_3$.

Decomp. by H_2O. Sol. in fuming H_2SO_4, conc. H_2SO_4. Sol. in H_2SO_4 of 1·806 sp. gr without decomp. (Weber, Pogg. **156**. 531.)

Decomp. by H_2O; sol. in H_2SO_4. (Divers and Shimosé, B. **17**. 858.)

Seleniuretted hydrogen, H_2Se.

See **Hydrogen selenide.**

Selenocyanhydric acid, $HSeCN$.

Known only in aqueous solution.

Ammonium selenocyanide, NH_4SeCN.

Very deliquescent, and sol. in H_2O.

Barium ——, $Ba(SeSCN)_2$.

Very sol. in H_2O.

Lead ——, $Pb(SeCN)_2$.

Sl. sol. in cold, sol. with sl. decomp. in boiling H_2O. Insol. in alcohol.

Mercurous ——, $Hg_2(SeCN)_2$.

Ppt.

Mercuric ——, $Hg(SeCN)_2$.

Sl. sol. in cold H_2O. Easily sol. in MCN, MSCN, or MSeCN + Aq; also sol. in hot $HgCl_2$ + Aq. (Cameron and Davy, C. N. **44.** 63.)

Mercuric potassium ——, $Hg(SeCN)_2$, $KSeCN$.

Easily sol. in H_2O. Sl. sol. in cold alcohol. (Cameron and Davy, C. N. **44.** 63.)

Platinum potassium —— (Potassium platinoselenocyanide), $K_2Pt(SeCN)_6$.

Sol. in H_2O and alcohol. (Clarke, B. **11.** 1325.)

Potassium ——, $KSeCN$.

Very deliquescent, and sol. in H_2O with absorption of heat. More sol. in H_2O than KSCN. Sol. in alcohol.

Potassium —— mercuric bromide, $KSeCN$, $HgBr_2$.

Sl. sol. in cold, more easily in hot H_2O or alcohol. (Cameron and Davy, C. N. **44.** 63.)

Potassium —— mercuric chloride, $KSeCN$, $HgCl_2$.

As the bromide.

Potassium —— mercuric iodide, $KSeCN$, HgI_2.

Sl. sol. in cold, easily in hot H_2O or alcohol. (Cameron and Davy.)

Potassium —— mercuric sulphocyanide, $KSeCN$, $Hg(SCN)_2$.

Sl. sol. in cold, much more in hot H_2O or alcohol. Somewhat sol. in ether. (Cameron and Davy.)

Silver ——, $AgSeCN$.

Insol. in H_2O. Almost insol. in NH_4OH + Aq or cold dil. acids. Quickly decomp. by hot conc. acids.

Sodium ——, $NaSeCN$.

Very sol. in H_2O.

Selenodithionic acid, H_2SeOS_3.

See **Selenosulphuric acid.**

Selenohyposulphurous acid, H_2SeSO_3.

See **Selenosulphuric acid.**

Selenosamic acid, $HSeO_2NH_2$.

Known only in its salts.

Ammonium selenosamate, $(NH_4)SeO_2NH_2$.

Deliquescent. Decomp. slowly by H_2O into $(NH_4)_2SeO_3$. Sol. in warm alcoholic ammonia.

Ammonium hydrogen selenosamate, $NH_4H(SeO_2NH_2)_2$.

Deliquescent. Sol. in 14 pts. alcohol at 14°. (Cameron and Macallan, Proc. Roy. Soc. **44.** 112.)

Selenostannic acid.

Ammonium selenostannate, $3SnSe_2$, $(NH_4)_2Se + 3H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

Platinum potassium ——, K_2Se, $3PtSe$, $SnSe_2$.

Insol. in hot or cold H_2O, NH_4OH, or KOH + Aq. Not attacked by hot HCl + Aq. (Schneider, J. pr. (2) **44.** 507.)

Potassium ——, $K_2SnSe_3 + 3H_2O$.

Easily sol. in H_2O. (Ditte, C. R. **95.** 441.)

Sodium ——, Na_2Se, $3PtSe$, $SnSe_2$.

Properties as the corresponding K salt. (Schneider.)

Selenosulphantimonic acid.

Sodium selenosulphantimonate, $Na_3SbSeS_3 + 9H_2O$.

Sol. in H_2O. (Hofacker, A. **107.** 6.)

Selenosulphostannic acid.

Potassium selenosulphostannate, $K_2SnSe_2S + 3H_2O$.

Very easily sol. in H_2O. (Ditte, C. R. **95.** 641.)

Sodium ——, $Na_2SnSe_2S + 3H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

Selenosulphur *tri*oxide, $SeSO_3$.

See **Selenium sulphoxide.**

Selenosulphuric acid, H_2SeSO_3.

Known only in its salts.

Potassium selenosulphate, $K_2SeSO_3 + xH_2O$.

Deliquescent in moist air; decomp. by H_2O. (Rathke, J. pr. **95.** 1.)

Selenotrithionic acid, $H_2S_2SeO_6$.

Known only in solution, which is stable in dark. (Schulze, J. pr. (2) **32.** 390.)

Barium selenotrithionate.

Sol. in H_2O. (Rathke.)

Potassium ——, $K_2SeS_2O_6$.

Sol. in H_2O with gradual decomp. (Rathke, J. pr. **95.** 8; **97.** 56.)

*Di*selenotrithionic acid, $H_2SSe_2O_6$.

Exceedingly unstable. (Schulze.)

Selenyl bromide, $SeOBr_2$ (?).

(Schneider, Pogg. **129.** 450.)

Selenyl chloride, SeO_2Cl_2.

Easily decomp. by H_2O. (Weber, Pogg. **118**. 615.)

Selenyl sulphur chloride.

See **Sulphoselenyl chloride.**

Selenyl stannic chloride, $2SeOCl, SnCl_4$.

Extremely deliquescent. Completely sol. in H_2O. (Weber, B. A. B. **1865**. 154.)

Selenyl titanium chloride, $2SeOCl_2, TiCl_4$.

Decomp. by H_2O with separation of an insol. residue. Decomp. by NH_4OH+Aq. (Weber, B. A. B. **1865**. 154.)

Sesquiauramine.

*See Sesqui***auramine.**

Sesquihydraurylamine, $(HOAu)_3N, NH_3$.

*See Sesqui***hydraurylamine.**

Silicic acid, SiO_2, xH_2O.

See also **Silicon** *di***oxide.**

Silicic acid is sol. in 1000 pts. pure H_2O. (Kirwan.)

When pptd. from alkali silicates+Aq by CO_2, 0·021 pt. SiO_2 remains dissolved in 100 pts. H_2O. (Struckmann, A. **94**. 341.)

When pptd. as above, 100 pts. H_2O dissolve 0·09 pt. SiO_2 in 3 days; 100 pts. H_2CO_3+Aq dissolve 0·078 pt. SiO_2 in 3 days. But if heated much more dissolves, the jelly itself becoming liquid, such jelly containing 2·49 pts. SiO_2 to 100 pts. H_2O. This solution is not pptd. by considerable quantities of alcohol, but conc. $(NH_4)_2CO_3$, NaCl, or $CaCl_2$+Aq, etc., cause gelatinisation. (Maschke, J. pr. **68**. 234.)

Solubility in H_2O depends on the amt. of H_2O, in presence of which the silicic acid is set free by dil. acids, CO_2, or alkali salts+Aq. If H_2O is present in sufficient quantity to retain the silicic acid, much more will remain in solution than can be dissolved by digesting the gelatinous acid with H_2O afterwards. 1 pt. SiO_2 can thus be held in solution by 500 pts. H_2O. Presence of NH_4OH, $(NH_4)_2CO_3$, or NH_4Cl (in solutions of which SiO_2 is remarkably insol.) diminishes the power of H_2O to retain SiO_2 in solution. SiO_2 is always more sol. in dil. than conc. NH_4OH+Aq. (Liebig, A. **94**. 373.)

Silicic acid from the coagulation of the colloidal form (*see* p. 361) is sol. in about 5000 pts. H_2O when formed from a 1 % solution, and 10,000 pts. when formed from a 5 % solution, but is insol. after being dried. (Graham, A. **121**. 36.)

Silicic acid is more sol. in dil. acids than in H_2O, because, when acid is added in excess to moderately dil. K_2SiO_3 + Aq, the solution remains clear, but if only enough acid is added to neutralise the base present, silicic acid will gradually separate out. If acid is added to conc. K_2SiO_3+Aq, silicic acid separates out insol. in excess of acid, but if 20-30 pts. H_2O are present to 1 pt. K_2SiO_3, and an excess of acid added at once, the silicic acid will remain in solution. This result is obtained with HCl, HNO_3, H_2SO_4, or $HC_2H_3O_2$+Aq. These solutions may dissolve a neutral salt until saturated and no silicic acid will separate out. Therefore it is the acid that holds the SiO_2 in solution, and not the H_2O. (C. J. B. Karsten, (**1826**) Pogg. **6**. 353.)

Even CO_2 has the power of holding SiO_2 in solution. (Karsten, *l.c.*)

Solubility in acids of silicic acid of Struckmann (*see* above): 100 pts. dil. HCl+Aq of 1·088 sp. gr. dissolve 0·0172 g. SiO_2 in 11 days; 100 pts. H_2O sat. with CO_2 dissolve 0·0136 g. SiO_2 in 7 days.

Silicic acid obtained by passing SiF_4 into H_2O is sol. while still moist in 11,000 pts. cold, and 5500 pts. boiling HCl+Aq of 1·115 sp. gr. (Fuchs, A. **82**. 119.)

Silicic acid at the moment of separation (as in dissolving cast-iron, steel, etc.) is abundantly sol. in aqua regia (3 pts. HCl+Aq of sp. gr. 1·13 and 1 pt. HNO_3+Aq of sp. gr. 1·33). (Wittstein, Z. anal. **7**. 433.)

NH_4OH+Aq dissolves considerable freshly precipitated silicic acid, $(NH_4)_2CO_3$ only a very little. (Karsten, Pogg. **6**. 357.)

Dry or ignited SiO_2 is sol. in NH_4OH+Aq. 100 pts. NH_4OH+Aq containing 10 % NH_3 dissolve: 0·714 pt. SiO_2 from gelatinous silicic acid; 0·303 pt. from artificially dried silicic acid; 0·377 pt. from amorphous SiO_2; 0·017 pt. from quartz. (Pribram, Z. anal. **6**. 119.)

NH_4OH+Aq dissolves 0·382 pt. SiO_2 from dry silicic acid: 0·357 pt. from ignited SiO_2; 0·00827 pt. from quartz. (Souchay, Z. anal. **11**. 182.)

Silicic acid precipitated from alkali silicates +Aq with CO_2 is sol. as follows: 100 pts. pure H_2O dissolve 0·021 pt. SiO_2; 100 pts. $(NH_4)_2CO_3$+Aq containing 5 % $(NH_4)_2CO_3$, 0·020 pt.; 100 pts. containing 1 % $(NH_4)_2CO_3$, 0·062 pt.; 100 pts. NH_4OH+Aq containing 19·2 % NH_3, 0·071 pt.; 100 pts. containing 1·6 %, 0·0986 pt. (Struckmann, A. **94**. 341.)

100 pts. NH_4OH+Aq (10 % NH_3) dissolve of: crystallised SiO_2, 0·017 pt.; amorphous SiO_2, ignited, 0·38 pt.; amorphous $3SiO_2, 4H_2O$, 0·21 pt.; amorphous silicic acid in form of jelly, 0·71 pt. Upon evaporation no ppt. is formed, even when 80 mols. SiO_2 are present to 1 mol. NH_3. (Wittstein, J. B. **1866**. 192.)

Sol. in KOH or NaOH+Aq, especially if warm. (Dumas.)

Sol. in K_2SiO_3 or Na_2SiO_3+Aq. (Fuchs.)

Easily sol. in boiling Na_2CO_3+Aq, separating as a jelly on cooling. (Pfaff.)

NH_4Cl or other NH_4 salts ppt. SiO_2 from solution in Na_2CO_3+Aq.

100 pts. Tl_2O in H_2O dissolve 4·17 pts. amorphous SiO_2 in 24 hours' boiling. (Flemming, Jena. Zeit. **4**. 36.)

Sol. in butyl amine. (Wurtz, A. ch. (3) **42**. 166.)

Not more sol. in H_2O containing sugar than in pure H_2O. (Petzholdt, J. pr. **60**. 368.)

Soluble silicic acid.

Colloidal form by dialysis. Solutions containing 4·9 % SiO_2 may be evaporated until they contain 14 % SiO_2. The SiO_2 is separated from its solution thus made in many ways—

(1) By standing. This happens the more easily the more conc. the solution is, and is hastened by heat. A 10-12 % solution gelatinises at ordinary temp. in a few hours, and immediately upon heating. A 5-6 % solution may be kept 5-6 days, a 2 % solution, 2-3 months, and a 1 % solution may be kept 2 or more years without gelatinising.

(2) When the solution is evaporated to dryness in vacuo at 15° a transparent glass is left which is insol. in H_2O.

(3) The coagulation of colloidal silicic acid is accelerated by powdered graphite and other indifferent bodies, and it is brought about in a few minutes by a solution of the alkali carbonates, even when only $\frac{1}{10000}$ pt. of the carbonate is present. (Graham, A. **121**. 36.)

(4) Coagulation is also brought about by passing CO_2 through the solution. (Liebig.)

CO_2 does not cause coagulation. (Maschke.)

Coagulation is not caused by H_2SO_4, HCl, HNO_3, $HC_2H_3O_2$, $H_2C_4H_4O_6$, or NH_4OH+Aq, or by neutral or acid salts + Aq. (Graham.)

NaCl and Na_2SO_4+Aq coagulate the solution. (Maschke.)

Alcohol, sugar, glycerine, or caramel do not coagulate.

Soluble $Al_2O_6H_6$, $Fe_2O_6H_6$, albumen, and casein precipitate soluble SiO_2. (Graham, A. **121**. 36.)

The jelly from colloidal SiO_2 is very sol. in slightly alkaline H_2O. 1 pt. NaOH in 10,000 pts. H_2O dissolves in an hour at 100° an amt. of the jelly corresponding to 200 pts. SiO_2. (Graham.)

Other colloidal forms.

Various solutions of silicic acid may be obtained as follows:

The jelly formed when SiF_4 is passed through H_2O dissolves in a large amt. of H_2O, and SiO_2 separates out on evaporation. This is still sol. in H_2O, but is made insol. by evaporation with HCl or H_2SO_4. (Berzelius.)

When SiF_4 is absorbed by crystallised H_3BO_3, and the HF and H_3BO_3 removed by a large excess of NH_4OH+Aq, a silicic acid is obtained which is very sol. in H_2O. The solution is not decomp. by boiling, but on evaporation an insol. powder remains. (Berzelius, A. ch. **14**. 366.)

When K_2SiO_3+Aq is precipitated by $CuCl_2$, the precipitate washed and dissolved in $HCl+Aq$, the solution treated with H_2S filtered and boiled, a solution of silicic acid is obtained which gelatinises with KOH or NH_4OH+Aq. (Doveri, A. ch. (3) **21**. 40.)

When Na_2SiO_3+Aq containing at most 3 % SiO_2 is saturated with $HCl+Aq$ of 1·10 sp. gr., and Na_2SiO_3 added until the solution is slightly opalescent and carefully warmed to 30°, a gelatinous mass is obtained which will dissolve in H_2O by 12-16 hours' boiling if treated before being exposed to the air. The solution is slightly opalescent. The solution can be evaporated by heat until it contains 6 % SiO_2. In a vacuum or over H_2SO_4, solutions containing 10 % may be obtained. The electric current, freezing, alcohol, or H_2SO_4 precipitate or coagulate the solution. (Kühn, J. pr. **59**. 1.)

SiS_2 with H_2O gives off H_2S, and forms a solution of SiO_2 which, after dilution, can be kept for months. But when boiled or evaporated, or when a sol. silicate is added, it becomes gelatinous. It leaves an insol. residue when evaporated to dryness. (Fremy, A. ch. (3) **38**. 314.)

Various forms of silicic acid have been described as definite compounds of SiO_2 with varying amounts of H_2O, but it is doubtful if any true definite compounds exist, as the percentage of H_2O varies with the moisture of the air to which it is exposed. (*See* Ebelmen, A. ch. (3) **16**. 129; Doveri, A. ch. (3) **21**. 40; Fuchs, A. **82**. 19; Merz, J. pr. **99**. 177; van Bemmelen, B. **11**. 2232, etc.)

Silicates.

The silicates are insol. in H_2O with the exception of the alkali salts, and these are sol. only when the ratio of the base to the acid is above a certain limit.

Aluminum silicate, $2Al_2O_3$, SiO_2+10H_2O.

Min. *Collyrite.* Sol. in acids, with formation of SiO_2, xH_2O. Becomes transparent in H_2O and is decomp.

$4Al_2O_3$, $3SiO_2$. Min. *Dillnite.*

Al_2O_3, SiO_2. Min. *Andalusite*, *Chiastolite*, *Sillimannite*, *Disthene* or *Cyanite*. Insol. in acids.

$+5\text{-}7H_2O$. Min. *Allophane.* Completely sol. in dil. acids; decomp. by conc. acids with separation of SiO_2, xH_2O.

$2Al_2O_3$, $3SiO_2+4H_2O$. Min. *Pholerite.* Insol. in HNO_3+Aq.

$+6H_2O$. Min. *Glagerite.*

Al_2O_3, $2SiO_2+2H_2O$. Min. *Kaolin*, *Clay.* Insol. in dil. HCl or HNO_3+Aq; moderately dil. H_2SO_4+Aq, when heated to evaporation, extracts Al_2O_3 and some SiO_2, and leaves the rest of the SiO_2, sol. in boiling Na_2CO_3+Aq. All the Al_2O_3 is dissolved by heating with 5-6 pts. H_2SO_4+1 pt. H_2O until H_4SO_4 evaporates, and then treating with H_2O.

Quickly attacked by H_2SiF_6+Aq.

Decomp. by boiling $KOH+Aq$, with residue of SiO_2. (Rammelsberg.)

$KOH+Aq$ extracts $\frac{1}{4}$ of the SiO_2 (Malaguti); is converted thereby into double silicates of K and Al, which are sol. in $HCl+Aq$. (Lemberg.)

Colloidal clay. (Schlösing, C. R. **79**. 473.)

$+4H_2O$. *Halloysite.* Decomp. by acids.

$4Al_2O_3$, $9SiO_2+12H_2O$. Min. *Porcelain clay* from Passau.

Al_2O_3, $3SiO_2+3H_2O$. Min. *Razoumoffskine.*

Al_2O_3, $4SiO_2+7H_2O$. Min. *Montmorillonite.* Not decomp. by $HCl+Aq$, but by hot H_2SO_4.

$+H_2O$. Min. *Pyrophyllite.* Not decomp. by H_2SO_4.

$+3H_2O$. Min. *Anauxite.*

$2Al_2O_3$, $9SiO_2+6H_2O$. Min. *Cimolite.*

Aluminum barium silicate, Al_2O_3, BaO, $2SiO_2+H_2O$ (?).

Min. *Edingtonite.* Decomp. by HCl+Aq with separation of SiO_2, xH_2O.

$5Al_2O_3$, 4BaO, $10SiO_2$. (Fremy and Feil, C. R. **85.** 1033.)

$2Al_2O_3$, 4BaO, $7SiO_2$. Min. *Barylite.* Very sl. decomp. by alkali carbonates +Aq. (Blomstrand.)

Aluminum barium potassium silicate, Al_2O_3, $(Ba,K_2)O$, $5SiO_2+2H_2O$.

Min. *Harmotome.* When finely powdered, difficultly decomp. by HCl+Aq with separation of pulverulent SiO_2, xH_2O.

Al_2O_3, $(Ba,K_2)O$, $4SiO_2$. Min. *Hagalophane.* Scarcely attacked by acids.

Aluminum cæsium silicate, $H_2Cs_2Al_2Si_5O_{15}$ (?).

Min. *Pollucite.* Very sl. decomp. by HCl+Aq.

Aluminum calcium silicate, Al_2O_3, CaO, $2SiO_2$.

Min. *Anorthite.* Completely decomp. by HCl+Aq with separation of pulverulent SiO_2, xH_2O.

Min. *Barsowite.* Instantaneously decomp. by HCl+Aq, with separation of gelatinous SiO_2, xH_2O.

$+4H_2O$. Min. *Gismondite.* Gelatinises with HCl+Aq.

Al_2O_3, CaO, $3SiO_2+3H_2O$. Min. *Scolezite.* Easily sol. in HCl+Aq, without formation of gelatinous SiO_2. Sol. in $H_2C_2O_4$+Aq with pptn. of CaC_2O_4.

Decomp. by, and sol. to a certain extent in H_2CO_3+Aq, and decomp. also even by pure H_2O. (Rogers, Am. J. Sci. (2) **5.** 408.)

$+5H_2O$. Min. *Levyn.* Decomp. by acids without gelatinising.

Al_2O_3, CaO, $4SiO_2+3H_2O$. Min. *Caporcianite. Leonhardite.* Efflorescent. Easily sol. in acids, with pptn. of gelatinous SiO_2, xH_2O.

Al_2O_3, CaO, $4SiO_2+4H_2O$. Min. *Laumontite.* Easily gelatinises with HCl or HNO_3+Aq, but is not affected by H_2SO_4 unless hot.

Al_2O_3, CaO, $6SiO_2+5H_2O$. Min. *Epistilbite.* Gelatinises with conc. HCl+Aq. (Goldschmidt, Z. anal. **17.** 267.)

Scarcely decomp. by boiling conc. HCl+Aq. (Jannasch and Tenne, Miner. Jahrb. **1880, 1.** 43.)

$+6H_2O$. *Stilbite. Heulandite.* Slowly but completely gelatinised by HCl+Aq.

Al_2O_3, 2CaO, $3SiO_2+H_2O$. Min. *Prehnite.* Imperfectly decomp. by acids before ignition, but easily afterwards.

Al_2O_3, 3CaO, $3SiO_2$. *Lime alumina garnet. Grossularite.* Partially decomp. by acids before ignition, but easily afterwards.

$2Al_2O_3$, CaO, $2SiO_2+H_2O$. *Margarite.* Not attacked by acids.

$3Al_2O_3$, 4CaO, $6SiO_2+H_2O$. *Zoisite.* Partially decomp. by HCl+Aq.

$4Al_2O_3$, 6CaO, $9SiO_2$. Min. *Meionite.* Completely sol. in HCl+Aq.

Aluminum calcium ferric silicate, $2Al_2O_3$, 4CaO, Fe_2O_3, $6SiO_2+H_2O$.

Min. *Epidote.* Only sl. attacked by HCl+Aq before ignition.

Aluminum calcium ferric magnesium silicate, $H_{14}(Ca,Mg)_{40}(Al_2,Fe_2)_{10}Si_{35}O_{147}$.

Min. *Vesuvianite, Idiocrase.* Only partially decomp. by HCl+Aq before ignition.

Aluminum calcium iron, etc., silicate borate, $H_2R^{II}_6(Al_2,B_2)_3Si_8O_{32}$.

Min. *Axinite.* Not attacked by HCl+Aq before ignition.

Aluminum calcium magnesium silicate, $4H_4Ca_2Mg_8Si_6O_{24}$, $5H_2CaMgAl_6O_{12}$ = $15Al_2O_3$, 13CaO, 37MgO, $24SiO_2+13H_2O$.

Min. *Clintonite.* Completely decomp. by HCl+Aq without gelatinisation.

$3H_4Ca_2Mg_8Si_6O_{24}$, $4H_2CaMgAl_6O_{12}$. Min. *Brandisite.* Not attacked by HCl+Aq. Slowly decomp. by boiling conc. H_2SO_4.

$5H_4Ca_2Mg_8Si_6O_{24}$, $8H_2CaMgAl_6O_{12}$. Min. *Xanthophyllite.* Very sl. decomp. by hot HCl+Aq.

$3(Ca,Mg)O$, Al_2O_3, $2SiO_2$. Min. *Gehlenite.* Easily decomp. by acids.

Aluminum calcium potassium silicate, $(H, K)_2CaAl_2Si_5O_{15}+6H_2O$.

Min. *Chabasite.* Decomp. by HCl+Aq.

$(K_2, Ca)Al_2Si_3O_{10}+4H_2O$. Min. *Zeagonite.* Completely sol. in HCl+Aq.

Aluminum calcium sodium silicate, $3Al_2O_3$, 8CaO, Na_2O, $9SiO_2$.

Min. *Sarcolite.* Decomp. by acids.

$2Al_2O_3$, $12(Ca, Na_2)O$, $9SiO_2$ (?). Min. *Mellilite.* Gelatinised by acids.

$Na_2CaAl_4Si_2O_{12}$ (?). Min. *Margarite.*

$Na_2CaAl_4Si_{10}O_{28}$. Min. *Faujasite.* Decomp. by HCl+Aq.

$(Na_2,Ca)Al_2Si_4O_{12}$. Min. *Gmelinite.* Decomp. by HCl+Aq.

$(Ca,Na_2)Al_2Si_6O_{19}+6H_2O$. Min. *Foresite.* Difficultly decomp. by HCl+Aq.

$(Ca,Na_2)Al_2Si_2O_8+2\frac{1}{2}H_2O$. Min. *Thomsonite.* Gelatinises with HCl+Aq.

$xNa_2Al_2Si_6O_{16}$, $yCaAl_2Si_2O_8$. Min. *Oligoclase, Labradorite.* Sl. decomp. by acids, more easily the larger the amt. of Ca present.

Aluminum calcium sodium silicate sulphate, $2(Na_2,Ca)Al_2(SiO_4)_2,(Na_2,Ca)SO_4$.

Min. *Hauyn.* Gelatinises with HCl+Aq.

Aluminum glucinum silicate, Al_2O_3, 3GlO, $6SiO_2$.

Min. *Beryl. Emerald.* Not decomp. by acids, excepting partially by H_2SO_4 after being ignited.

Al_2O_3, 2GlO, $2SiO_2+H_2O$. Min. *Euclase.* Not attacked by acids.

Aluminum ferrous silicate, $Al_2Fe(SO_4)_3$.

Min. *Garnet.* Sl. decomp. by HCl+Aq.

$H_2FeAl_2SiO_7$. Min. *Chloritoid.* Not attacked by HCl+Aq. Completely decomp. by H_2SO_4.

Al_2O_3, 3FeO, $3SiO_2+3H_2O$. Min. *Voigtite.*

Aluminum iron lithium potassium silicate, $K_3Li_3Fe_4Al_{12}Si_{20}O_{65}$.

Min. *Zinnwaldite.* Sl. decomp. by acids.

Aluminum ferrous magnesium silicate, $6Al_2O_3$, $3(Mg,Fe)O$, $6SiO_2+H_2O$.

Min. *Staurolite.* Not attacked by acids.

Aluminum ferric magnesium silicate, $2(Al_2,Fe_2)O_3$, $2MgO$, $5SiO_2$.

Min. *Cordierite.* Sl. attacked by acids.

$+xH_2O$. Min. *Esmarkite, Chlorophyllite.*

Aluminum ferrous manganous silicate, Al_2O_3, FeO, $2MnO$, $3SiO_2$.

Min. *Partschinite.*

Aluminum ferrous sodium, etc., silicate borate, $R_6^{I}(Al_2)_2(B_2)Si_4O_{20}+R_3^{II}(Al_2)_2(B_2)Si_4O_{20}$, etc.

Min. *Tourmaline.* Not decomp. by HCl+Aq; very sl. decomp. by H_2SO_4.

Aluminum lithium silicate, Al_2O_3, Li_2O, $5SiO_2$.

Not attacked by acids. (Hautefeuille, C. R. **90**. 541.)

Al_2O_3, Li_2O, $6SiO_2$.

Al_2O_3, Li_2O, $4SiO_2$. Min. *Spodumene.* Not attacked by acids.

$4Al_2O_3$, $3Li_2O$, $30SiO_2$. Min. *Petalite.* Not attacked by acids.

Aluminum lithium potassium silicate, $(Li,K)_{10}Al_{10}Si_{16}O_{52}$.

Min. *Lepidolite.* Sl. decomp. by acids.

Aluminum magnesium silicate, $5Al_2O_3$, $4MgO$, $2SiO_2$. Min. *Sapphirine.*

Aluminum magnesium potassium silicate, $xH_4K_2Al_6Si_6O_{24}$, $yMg_{12}Si_6O_{21}$.

Min. *Lepidomelane.* Easily decomp. by HCl or HNO_3+Aq, with residue of a skeleton of SiO_2.

$3Al_2O_3$, $12MgO$, $2K_2O$, $12SiO_2+H_2O$. Min. *Anomite.*

$7Al_2O_3$, $35MgO$, $7K_2O$, $36SiO_2$. Min. *Phlogopite.*

Aluminum manganous silicate, $2Al_2O_3$, $6MnO$, $6SiO_2$.

Not decomp. by very dil. HCl+Aq. (Gorgeu, C. R. **97**. 1303.)

Aluminum potassium silicate, Al_2O_3, K_2O, SiO_2.

Very slowly decomp. by cold H_2O; 12 % is dissolved by hot H_2O. Sol. in alkali hydroxides +Aq, but insol. in carbonates+Aq.

K_2O, Al_2O_3, $2SiO_2$. Insol. in cold H_2O, but 6 % dissolves on boiling. Sol. in dil. acids. Insol. in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) **10**. 45.)

K_2O, Al_2O_3, $3SiO_2+3H_2O$. Easily sol. in HNO_3+Aq. (Deville, A. ch. (3) **61**. 313.)

K_2O, Al_2O_3, $4SiO_2$. Min. *Leucite.* Decomp. by HCl+Aq with separation of pulverulent SiO_2.

$+4H_2O$. Ppt. (Deville, C. R. **54**. 324.)

$H_4K_2Al_6Si_6O_{24}$. Min. *Muscovite,* "*Mica.*" Not attacked by HCl or H_2SO_4+Aq.

$K_2Al_4Si_5O_{17}+3H_2O$. Min. *Pinite.* Partly decomp. by HCl+Aq.

$K_2Al_2Si_6O_{16}$. Min. *Orthoclase Feldspar.* Scarcely attacked by acids. Slowly sol. in H_2SO_4 or HCl+Aq when finely powdered. (Rogers.)

Aluminum potassium sodium silicate, $K_2Al_2(SiO_3)_4$, $5Na_2Al_2(SiO_4)_2$ (?).

Min. *Nepheline.* Decomp. by HCl+Aq.

Aluminum silver silicate, $Al_2Ag_4Si_2O_9$.

Insol. in NH_4OH+Aq. (Silber, B. **14**. 941.)

$Al_6Ag_2Na_4Si_6O_4$. As above. (Silber.)

Aluminum sodium silicate, Al_2O_3, Na_2O, SiO_2.

Insol. in cold H_2O, but 38-40 % dissolves in hot H_2O. (Gorgeu.)

Al_2O_3, Na_2O, $2SiO_2$. Insol. in cold H_2O; boiling H_2O dissolves 1-2 %. Sol. in HCl or HNO_3 diluted with 10-20 vols. H_2O. Insol. in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) **10**. 145.)

Not attacked by H_2O. (Silber, B. **14**. 941.)

$+3H_2O$. Easily sol. in HCl+Aq. (v. Ammon.)

Al_2O_3, Na_2O, $3SiO_2+3H_2O$. Decomp. by acids. (Deville, A. ch. (3) **61**. 326.)

Al_2O_3, Na_2O, $4SiO_2+3H_2O$. Easily sol. in HCl+Aq. (v. Ammon.)

$2Al_2O_3$, $3Na_2O$, $3SiO_2$. Insol. in cold H_2O, but 27-30 % dissolves on boiling. (Gorgeu.)

$H_4Na_2Al_6Si_6O_{24}$. Min. *Paragonite.* Decomp. by conc. H_2SO_4.

$Na_2Al_2Si_4O_{12}+2H_2O$. Min. *Analcite.* Readily decomp. by HCl+Aq.

$Na_2Al_2Si_3O_{10}+2H_2O$. Min. *Natrolite.* Sol. in H_2O with separation of SiO_2. Also sol. in $H_2C_2O_4$+Aq.

$Na_2Al_2Si_6O_{16}$. Min. *Albite.* Not attacked by acids.

Aluminum sodium silicate chloride, $3Na_2Al_2(SiO_4)_2$, $2NaCl$.

Min. *Sodalite.* Easily decomp. by HCl, and HNO_3+Aq.

Aluminum sodium silicate sulphate, $3Na_2Al_2(SiO_4)_2$, Na_2SO_4.

Min. *Nosean.* Easily decomp. by HCl+Aq.

Aluminum sodium silicate sulphide.

See **Ultramarine.**

Barium silicate, $BaSiO_3$.

Somewhat sol. in boiling H_2O. Completely sol. in dil. HCl+Aq. (v. Ammon.)

$+6H_2O$, or $7H_2O$. Boiling H_2O decomposes, and dissolves about $\frac{1}{2}$ the weight of this substance. (le Chatelier, C. R. **92**. 931.)

$2BaO$, SiO_2. Decomp. by H_2O into $BaSiO_3+6H_2O$. (Laudrin.)

Bismuth silicate, $2Bi_2O_3$, $3SiO_2$.

Min. *Eulytite.* Decomp. by HCl+Aq.

Bismuth ferric silicate, $Bi_2Fe_4Si_4O_{17}$.

Min. *Bismuthoferrite.*

Boron calcium silicate.

See **Borate silicate, calcium,** *and* **Silicate borate, calcium.**

Cadmium silicate, $CdSiO_3+1\frac{1}{2}H_2O$.

Sol. in HCl+Aq with deposition of pulverulent SiO_2, xH_2O. (Rousseau and Tite, C. R. **114**. 1262.)

Calcium silicate, $CaSiO_3$.

Slowly sol. in H_2O; sol. in $HCl+Aq$.

$4CaO$, $3SiO_2$. (Laudrin.)

$5CaO$, $3SiO_2+5H_2O$. When freshly precipitated is somewhat sol. in H_2O and easily decomp. by $HCl+Aq$. (v. Ammon.)

CaO, $3SiO_2+2H_2O$. (Hjeldt, J. pr. **94**. 129.)

$2CaO$, $9SiO_2+3H_2O$. Ppt.

$CaSiO_3$. Min. *Wollastonite.* Gelatinises with $HCl+Aq$.

$CaSi_2O_5+2H_2O$. Min. *Okenite.* Easily decomp. by cold $HCl+Aq$ when powdered.

Calcium glucinum silicate sodium fluoride, $(Ca, Gl)_{15}Si_{14}O_{43}$, $6NaF$.

Min. *Leucophane.*

$7(Ca, Gl)_3Si_2O_7$, $6NaF$. Min. *Melinophane.*

Calcium ferrous silicate, $CaSiO_3$, $FeSiO_3$.

Min. *Hedenbergite*, *Pyroxene.* Sl. decomp. by acids.

Calcium ferric silicate, $Ca_3Fe_2(SiO_4)_3$.

Min. *Garnet.* Sl. decomp. by $HCl+Aq$.

$2CaSiO_3$, $11Fe_2(SiO_3)_3$. Min. *Szaboite.* Sl. attacked by $HCl+Aq$, and still less by H_2SO_4+Aq.

Calcium ferroferric silicate, $2CaO$, $4FeO$, Fe_2O_3, $4SiO_2+H_2O=H_2Ca_2Fe_4Fe_2Si_4O_{18}$.

Min. *Lievrite*, *Ilvaite.* Easily gelatinises with $HCl+Aq$.

Calcium ferrous magnesium silicate, $(Ca, Fe, Mg)SiO_3$.

Min. *Amphibole*, *Hornblende*, *Asbestos*, *Actinolite*, *Tremolite.* Only sl. attacked by acids.

Calcium ferroferric sodium silicate, $CaSiO_3$, $FeSiO_3$, $Fe_2(SiO_3)_3$, Na_2SiO_3.

Min. *Aegirite.*

Calcium magnesium silicate, CaO, MgO, $4SiO_2$.

(Mutschler, A. **176**. 86.)

Ca_2SiO_4, Mg_2SiO_4. Min. *Monticellite.* Completely sol. in dil. $HCl+Aq$.

$(Ca, Mg)SiO_3$. Min. *Diopside*, *Pyroxene.* Very sl. attacked by acids.

Calcium manganous silicate, $CaSiO_3$, $2MnSiO_3$.

Min. *Bustamite.*

Calcium potassium silicate.

See under **Glass.**

Calcium sodium silicate, $(Ca, Na_2, H_2)SiO_3$.

Min. *Pectolite.* Decomp. by $HCl+Aq$.

See under **Glass.**

Calcium sodium silicate zirconate, $Na_4Ca(Si, Zr)_9O_{21}+9H_2O$.

Min. *Wöhlerite.* Decomp. by $HCl+Aq$.

Calcium uranyl silicate, $3CaO$, $5UO_3$, $6SiO_2+18H_2O$.

Min. *Uranophane.* Gelatinises with acids.

CaO, $3UO_3$, $3SiO_2+9H_2O$. Min. *Uranotile.*

Calcium silicate chloride, $2CaO$, SiO_2, $CaCl_2$.

Insol. in H_2O or alcohol. Sol. in $HCl+Aq$. (le Chatelier, C. R. **97**. 1510.)

Calcium silicate fluoride, $2CaO$, $3SiO_2$, $6CaF_2$.

(Deville, C. R. **52**. 110.)

Calcium silicate potassium fluoride, $4H_2CaSi_2O_6$, $KF+4H_2O$.

Min. *Apophyllite.* Decomp. by $HCl+Aq$.

Calcium silicate stannate.

See **Silicostannate, calcium.**

Calcium silicate titanate, CaO, SiO_2, TiO_2.

(Hautefeuille, A. ch. (4) **4**. 154.)

Min. *Titanite.* Incompletely decomp. by $HCl+Aq$, wholly by H_2SO_4+Aq.

Cerous silicate, $Ce_2(SiO_3)_3$.

More or less attacked by HCl, HNO_3, or H_2SO_4+Aq, according to the concentration. (Didier, C. R. **101**. 882.)

Cerium didymium lanthanum silicate, $2(Ce, La, Di)_2O_3$, $3SiO_2$.

Min. *Cerite.* Gelatinises with $HCl+Aq$.

Cerium glucinum yttrium silicate, $(Y, Ce, Gl)_2SiO_5$.

Min. *Gadolinite.* Easily gelatinised by $HCl+Aq$.

Cerous silicate chloride, $2Ce_2O_3$, $3SiO_2$, $4CeCl_3=Ce_4(SiO_4)_3$, $4CeCl_3$.

Insol. in H_2O, but slowly decomp. thereby. (Didier, C. R. **101**. 882.)

Cobaltous silicate, Co_2SiO_4.

Gelatinises with $HCl+Aq$. (Bourgeois, C. R. **108**. 1077.)

Cupric silicate, CuH_2SiO_4.

Min. *Dioptase.* Sol. in HCl, HNO_3, or NH_4OH+Aq with separation of SiO_2. Not attacked by $KOH+Aq$.

$CuSiO_3+2H_2O$. Min. *Chrysocolla.* Decomp. by $HCl+Aq$.

$+3H_2O$. Min. *Asperolite.* Easily decomp. by $HCl+Aq$.

Cupric silicate ammonia, $CuSi_2O_5$, $2NH_3$.

Ppt. (Schiff, A. **123**. 38.)

Glucinum silicate, Gl_2SiO_4.

Min. *Phenacite.* Not attacked by acids.

Glucinum ferrous manganous silicate ferrous manganous sulphide, $3(Gl,Fe,Mn)_2SiO_4$, $(Mn, Fe)S$.

Min. *Helvine.* Decomp. by $HCl+Aq$.

Ferrous silicate, Fe_2SiO_4.

Min. *Fayalite.* Gelatinises with $HCl+Aq$.

$FeSiO_3$. Min. *Grunerite.*

$+6H_2O$. Min. *Chlorophite.*

$4FeO$, SiO_2. (Zobel, Dingl. **154**. 111.)

Ferric silicate, $Fe_2Si_3O_9+5H_2O$.

Min. *Nontronite.* Gelatinises with hot acids.

$4Fe_2O_3$, $9SiO_2+18H_2O$. Min. *Hisingerite.*

$2Fe_2O_3$, $9SiO_2+2H_2O$. Min. *Anthosiderite.*

Ferroferric magnesium silicate,
$(Fe, Mg)_3Fe_2Si_2O_{10} + 4H_2O$.

Min. *Cronstadtite.* Gelatinises with acids.

Ferroferric sodium silicate, $5Na_2SiO_3$,
$2FeSiO_3$, $4Fe_2(SiO_3)_3$.

Min. *Akmite.* Sl. decomp. by acids.

Ferrous magnesium silicate, Fe_2SiO_4, Mg_2SiO_4.

Min. *Olivene, Chrysolite, Peridote.* Gelatinises with HCl or H_2SO_4 + Aq.

$(Fe, Mg)SiO_3 + \frac{3}{2}H_2O$. Min. *Picrophyll.*

$+ \frac{1}{4}H_2O$. Min. *Monradite.*

$(Fe, Mg)SiO_3$. Min. *Bronzite, Hypersthene.* Not attacked by acids.

$xMgSiO_3$, $yFeSiO_3$. Min. *Anthophyllite.* Not attacked by acids.

Ferrous manganous silicate, Fe_2SiO_4, Mn_2SiO_4.

Min. *Knebelite.* Gelatinises with HCl + Aq.

Ferrous manganous silicate chloride,
$7(Fe, Mn)SiO_3$, $(Fe, Mn)Cl_2 + 5H_2O$.

Min. *Pyrosmalite.* Completely decomp. by conc. HNO_3 + Aq.

Ferric potassium silicate, $Fe(SiO_3)_3$, K_2SiO_3.

(Hautefeuille and Perrey, C. R. **107.** 1150.)

Ferric sodium silicate, $Na_2Fe_2Si_4O_{12}$.

Min. *Crokydolite.* Not attacked by acids.

Lead silicate.

See under **Glass.**

Lithium silicate, $Li_2Si_5O_{11}$.

Li_4SiO_4.

Li_2SiO_3.

Magnesium silicate, $Mg_3Si_2O_7 + 2H_2O$.

Min. *Serpentine.* Decomp. by HCl + Aq, more easily by H_2SO_4.

Min. *Chrysolite.*

$Mg_4Si_3O_{10} + 6H_2O$. Min. *Gymnite, Soapstone.* Decomp. by H_2SO_4.

$MgSiO_3$. Not completely decomp. by HCl + Aq.

$+ \frac{3}{4}H_2O$. Min. *Aphrodite.* Decomp. by hot acids.

$+ \frac{1}{2}H_2O$. Min. *Picrosmine.*

$+ 1\frac{3}{8}H_2O$. Sol. in dil. acids. (v. Ammon.)

Min. *Forsterite.*

$3MgO$, $4SiO_2 + H_2O$ or $4MgO$, $5SiO_2 + \frac{3}{4}H_2O$. Min. *Talc* or *Steatite.* Not attacked by HCl or H_2SO_4 + Aq.

$Mg_5Si_6O_{17} + 4H_2O$. Min. *Spadaite.* Decomp. by conc. HCl + Aq.

$Mg_2Si_3O_8 + 4H_2O$. Min. *Meerschaum.* Decomp. by HCl + Aq.

Magnesium silicate fluosilicate, $Mg_5Si_2O_9$,
$Mg_5Si_2F_{18}$.

Min. *Humite, Chondrodite.* Gelatinises with HCl or H_2SO_4 + Aq.

Manganous silicate, Mn_2SiO_4.

Min. *Tephroite.* Decomp. by HCl + Aq with formation of a stiff jelly.

$MnSiO_3$. Min. *Rhodonite, Hermannite.* Not attacked by HCl + Aq.

$Mn_4Si_3O_{10} + 2H_2O$. Min. *Friedelite.* Easily gelatinised by HCl + Aq.

Manganous zinc silicate, $(Mn, Zn)_2SiO_4$.

Min. *Troostite.*

Manganous silicate chloride, $MnSiO_3$, MnO,
$MnCl_2$.

Decomp. by H_2O. (Gorgeu.)

Nickel silicate, Ni_2SiO_4.

Easily decomp. by acids. (Bourgeois, C. R. **108.** 1077.)

Potassium silicate, K_2SiO_3.

Completely sol. in H_2O. (Ordway, Sill. Am. J. (2) **33.** 34.)

$K_2Si_4O_5$. Sol. in H_2O. Conc. $K_2Si_4O_5$ + Aq contains 28 % of the salt, and has sp. gr. 1·25. (Fuchs.)

$K_2Si_8O_{17}$. Partially sol. in H_2O as K_2SiO_3.

$K_2Si_{24}O_{49} + 16H_2O$. Insol. in H_2O. (Forchhammer.)

The K silicates are pptd. from their aqueous solution by alcohol with partial decomp., but less readily than Na silicates.

More sol. in H_2O than the corresponding Na salts. (Ordway, Sill. Am. J. (2) **32.** 155.)

Solution can be obtained which is perfectly clear when $4\frac{1}{2}SiO_2$ are present to $1K_2O$, if there are no impurities present. (Ordway.)

The K silicates resemble the Na salts, which see for further data.

Potassium zinc silicate.

Sol. in KOH + Aq. (Schindler.)

Potassium zirconium silicate, K_2O, ZrO_2,
$2SiO_2$.

Decomp. by HCl + Aq. (Melliss.)

Silver silicate, Ag_2SiO_3.

Decomp. by all acids; sol. in NH_4OH + Aq. (Hawkins, Sill. Am. J. **139.** 311.)

Sodium silicate, Na_2SiO_3.

+5, 6, 8, and $9H_2O$. Easily sol. in H_2O.

$Na_2Si_2O_5$. Sol. in H_2O.

$Na_4Si_5O_{12}$.

$Na_2Si_3O_7$.

$Na_2Si_4O_9$. Slowly sol. in H_2O.

$+ 12H_2O$.

Above compounds are all more or less indefinite.

Water glass. xNa_2O, $ySiO_2 + zH_2O$. Sol. in H_2O, but solution is decomposed by all weak acids, even CO_2.

Fused water glass is but little acted on by cold H_2O, but when pure, easily dissolves in H_2O by long boiling. (Ordway, Am. J. Sci. (2) **32.** 337.)

When the SiO_2 is present in greater proportion than in Na_2O, $3SiO_2$, it is very difficult to dissolve in H_2O.

Na silicate is less easily sol. in H_2O than the corresponding K compound.

Solubility of water glass in H_2O is much impaired by earthy impurities, so that traces have great effect in preventing the solubility.

NH_4 salts decomp. water glass solutions. A solution containing $\frac{1}{2}$ % Na_2SiO_3 is scarcely precipitated by NH_4Cl, but easily by NH_4NO_3. (Flückinger.)

Precipitated by NH_4OH + Aq as Na_2SiO_3.

Many sodium and potassium salts, especially the chlorides and acetates, form precipitates in solutions of water glass; these precipitates are larger the more concentrated the solution is, and the greater amount of SiO_2 it contains. Heating hastens the precipitation by chlorides, nitrates, and sulphates, but delays that by acetates. KOH+Aq does not precipitate.

Cold sat. Na_2SO_4+Aq does not precipitate even on heating, but 1 pt. anhydrous Na_2SO_4 dissolved in 2 pts. H_2O precipitates a hot solution of Na_2SiO_3.

$NaNO_3$ dissolved in 1 pt. H_2O precipitates Na_2SiO_3+Aq of 1·392 sp. gr.; $NaNO_3$ in 2 pts. H_2O when mixed with a solution of Na_2SiO_3, as above, if the two are present in equal vols., causes no ppt. in the cold, but solidifies when warmed to 54°, and redissolves on cooling rapidly, but if 2 vols. $NaNO_3$+Aq are present to 1 vol. Na_2SiO_3+Aq, the precipitate does not disappear on cooling.

If 1 pt. NH_4OH+Aq (0·921 sp. gr.) is added to 10 pts. Na_2SiO_3+Aq, no ppt. forms, but by increasing the amt. of NH_4OH+Aq to 2 pts., the greater pt. of the Na_2SiO_3 is pptd., but redissolves on heating to 90°, separating again on cooling. When 1 pt. NH_4OH+Aq is added to 6-8 pts. Na_2SiO_3+Aq and heated to 30°, a clear liquid is formed which separates into two layers at ordinary temp.

The most sol. K, Na, Li, and NH_4 salts separate SiO_2 from conc. Na_2SiO_3+Aq. Most of these salts lose this power by dilution, but the NH_4 salts and KSCN keep this power until the solution is very dil. This is especially the case with NH_4Cl and NH_4NO_3.

Bromine, chlorine, propyl amine, creosote, phenole dissolved in glycerine, chloral hydrate, dil. albumen solution, and glue solution ppt. SiO_2 from Na_2SiO_3+Aq; but sugar, dextrine, glycerine, urea, sl. alkaline solution of urea nitrate, coniine, nicotine, saponine, convolvuline, jalappine, and colophonium dissolved in KOH+Aq do not ppt. SiO_2. (Flückinger, Arch. Pharm. (2) **144**. 97.)

Alcohol ppts. water glass as such from its aqueous solution, even when this is very dil., but there is some decomposition, the alcohol tending to hold in solution a portion of a silicate more alkaline than that previously dissolved in H_2O, while the ppt. formed contains more SiO_2 than the original silicate.

Many neutral K or Na salts ppt. water glass as such when added to aqueous solutions. Like alcohol, these solutions exert a decomposing action, the ppt. being always more siliceous than the original silicate. Na silicate yields a larger deposit than K silicate; when a silicate of one base is pptd. by a salt of the other, both bases enter into the composition of the ppt, and the relative proportion of Na and K is very nearly the same as in the average of the liquids mixed.

Different salts have very unequal pptg. power, the acetates and chlorides being particularly efficient. Heat increases the pptg. power of the chlorides, sulphates, and nitrates, and diminishes that of the acetates. The alkali acetates are somewhat more efficient than the chlorides, but $NaC_2H_3O_2$ gives only a slight ppt. with Na_2O, $2\frac{1}{4}SiO_2$, even after some time.

$NaNO_3$ has but little effect on the more alkaline silicates.

Na_2SO_4 has still less power than $NaNO_3$.

Na_2CO_3 has no pptg. power, and Na_3AsO_4 or Na_3PO_4 have very little effect.

$MHSO_4$, $MHCO_3$, M_2HPO_4, M_2HAsO_4 ppt. SiO_2. NH_4 salts also have that effect.

Pptd. water glass, as mentioned above, is much more sol. in H_2O than ordinary water glass, and dissolves in H_2O without decomp. For numerous further details, see articles by Ordway in Sill. Am. J. Sci. vols. **32** and **33**; also Storer's Dict.

Sp. gr. of water glass solution containing 14-15 % SiO_2, 13-14 % Na_2O, and 70-72 % H_2O is 1·30-1·35. (Hager, Comm. **1883**.)

Sp. gr. of sat. Na_2SiO_3+Aq freshly prepared at 18° is 1·2600, and 1 litre contains 4·5 gramme-equivalents $\frac{1}{2}Na_2SiO_3$.

Sp. gr. of sat. solution of Na_2O, $3{\cdot}4SiO_2$ is 1·366, and 1 litre contains 3·7 gramme-equivalents $\frac{1}{2}(Na_2O, 3{\cdot}4SiO_2)$. (Kohlrausch, Z. phys. Ch. **12**. 773.)

Sodium zirconium silicate, Na_2O, ZrO_2, SiO_2.

Decomp. by hot H_2O or HCl+Aq. (Gibbs, Pogg. **71**. 559.)

Na_2O, $8ZrO_2$, SiO_2+11H_2O. Decomp. by H_2SO_4. (Melliss.)

Strontium silicate, $3SrO$, SiO_2.

Sl. sol. in H_2O. Sol. in acids. (Vauquelin.)

Thallous silicate, $3Tl_2O$, $10SiO_2$.

100 pts. of a solution of Tl_2O dissolve 4·17 pts. SiO_2 by 24 hours' boiling. Sol. in H_2O. (Flemming, J. B. **1868**. 251.)

Thorium silicate, ThO_2, SiO_2.

Insol. in acids. Attacked by $KHSO_4$. (Troost and Ouvrard, C. R. **105**. 255.)

$+1\frac{1}{2}H_2O$. Min. *Thorite.* Decomp. by HCl+Aq.

ThO_2, $2SiO_2$. Insol. in acids or $KHSO_4$. (T. and O.)

Yttrium silicate, Y_2O_3, SiO_2.

Attacked by HCl, HNO_3, or H_2SO_4+Aq. (Duboin, C. R. **107**. 99.)

Zinc silicate, Zn_2SiO_4.

Min. *Willemite.* Gelatinises with HCl+Aq; sol. in KOH+Aq.

Zinc silicate, $Zn_2SiO_4+H_2O$.

Min. *Calamine.* Sol. in HCl+Aq with separation of gelatinous SiO_2, xH_2O. Sol. in $HC_2H_3O_2$+Aq, and KOH+Aq.

Zirconium silicate, SiO_2, ZrO_2.

Min. *Zircon.* Insol. in acids, except H_2SO_4, in which it is very slowly and sl. sol.

$3SiO_2$, $2ZrO_2$. Min. *Auerbachite.*

"Silicium oxide," $Si_3H_2O_5$.

(Geuther, J. pr. **95**. 430.) This substance is identical with silicoformic anhydride according to Otto-Graham's Handb anorgan. Chem. 7te Aufl. **2**. 953.

Siliciuretted hydrogen.
See **Silicon hydride.**

Silicobromoform, $HSiBr_3$.
Fumes on air ; decomp. by H_2O.

Silicochloroform, $HSiCl_3$.
Decomp. by H_2O and alcohol.

Silicoformic anhydride, $H_2Si_2O_3=(HSiO)_2O$.
Somewhat sol. in H_2O. Acids, even conc. HNO_3+Aq, have no action, except HF, which dissolves it easily with evolution of hydrogen. Solutions of alkali hydrates, ammonium hydrate, and alkali carbonates + Aq also dissolve with evolution of hydrogen. (Buff and Wöhler, A. **104.** 101.)

Silicoiodoform, $HSiI_3$.
Decomp. by H_2O. Sol. in CS_2. (Friedel, A. **149.** 96.)

Silicomethane, SiH_4.
See **Silicon hydride.**

Silicomolybdic acid, $SiO_2, 12MoO_3+26H_2O$.
Very easily sol. in H_2O and dil. acids. (Parmentier, C. R. **94.** 213.)

Forms a solution with a little ether, which separates into two layers by addition of H_2O or more ether. (Parmentier, C. R. **104.** 686.)

Ammonium silicomolybdate.
Sol. in H_2O. (Parmentier, C. R. **94.** 213.)

Cæsium silicomolybdate.
Sl. sol. in H_2O ; insol. in silicomolybdic acid + Aq.

Potassium silicomolybdate.
Sol. in H_2O.

Rubidium silicomolybdate.
Sl. sol. in H_2O.

Silicon, Si.
Amorphous. Insol. in H_2O. Sol. before igniting in cold HF. Insol. in other mineral acids and aqua regia. Sol. in conc. KOH + Aq. When amorphous Si is ignited, it becomes insol. in HF and KOH + Aq.

Graphitic. Sol. in HNO_3 + HF. (Berzelius, A. **49.** 247.)

Crystalline. Insol. in all acids, except a mixture of HF and HNO_3. Sol. in moderately conc. KOH + Aq even when cold. (Deville.)

Silicon *tri*bromide, Si_2Br_6.
Decomp. by KOH + Aq. (Friedel and Ladenburg, A. **203.** 253.)
$HSiBr_3$. *See* **Silicobromoform.**

Silicon *tetra*bromide, $SiBr_4$.
Rapidly decomp. by H_2O ; decomp. in several days by H_2SO_4. (Friedel and Ladenburg, A. **147.** 362.)

***Di*silicon hydrogen *penta*bromide,** HSi_2Br_5 or Si_2Br_5 (?).
Decomp. by H_2O. (Mahn, Zeit. Chem. (2) **5.** 279.)

Silicon bromide ammonia, $SiBr_4, 7NH_3$.
Decomp. by H_2O. (Besson, C.R. **110.** 240.)

Silicon bromoiodide, $SiIBr_3$.
Decomp. by H_2O. Sol. in CS_2. (Friedel, B. **2.** 60.)
$SiBr_2I_2$. As above. (F.)
$SiBrI_3$. As above. (F.)

Silicon *sub*chloride, $SiCl_2$ (?).
Decomp. by H_2O. (Troost and Hautefeuille, A. ch. (5) **7.** 463.)

Silicon *tri*chloride, Si_2Cl_6.
Decomp. by H_2O and alkalies. (Troost and Hautefeuille, A. ch. (5) **7.** 459.)
$SiHCl_3$. *See* **Silicochloroform.**

Silicon *tetra*chloride, $SiCl_4$.
Decomp. by H_2O and alcohol.

Silicon chloride ammonia, $SiCl_4, 6NH_3$.
Decomp. by H_2O. (Persoz, A. ch. **44.** 319.)

Silicon *tri*chloride ammonia, $Si_2Cl_6, 5NH_3$.
Slowly decomp. by H_2O. (Besson, C. R. **110.** 516.)

Silicon chlorobromide, $SiCl_3Br$.
Decomp. by H_2O. (Friedel and Ladenburg, A. **145.** 187.)
$SiCl_2Br_2$. As above. (Friedel and Ladenburg.)
$SiBr_3Cl$. Decomp. by H_2O. (Reynolds, Chem. Soc. **51.** 590.)

Silicon chlorobromide ammonia, $2SiCl_3Br, 11NH_3$.
Decomp. by H_2O. (Besson, C. R. **112.** 788.)
$SiCl_2Br_2, 5NH_3$. As above. (B.)
$2SiClBr_3, 11NH_3$. As above. (B.)

Silicon chlorohydrosulphide, $SiCl_3SH$.
Decomp. by H_2O or alcohol. (Pierre, A. ch. (3) **24.** 286.)

Silicon chloroiodide, $SiCl_3I$.
Decomp. by H_2O. (Besson, C. R. **112.** 611.)
$SiCl_2I_2$. As above. (B.)
$SiClI_3$. As above. (B.)

Silver chloroiodide ammonia, $2SiCl_3I, 11NH_3$.
(Besson.)
$SiCl_2I_2, 5NH_3$.

Silicon chloronitride, $Si_5N_6Cl_2$.
(Schützenberger, C. R. **92.** 1508.)

Silicon chlorosulphide, $Si_2Cl_2S_2$.
Decomp. violently by H_2O. Sol. in CCl_4. (Besson, C. R. **113.** 1040.)

Silicon *di*fluoride, SiF_2 (?).
Decomp. by H_2O or NH_4OH + Aq. (Troost and Hautefeuille, A. ch. (5) **7.** 464.)

Silicon *tetra*fluoride, SiF_4.
Abundantly absorbed by H_2O with decomp.

100 pts. H_2O absorb 140·6 pts. SiF_4 in 24 hours (Berzelius) ; 124·1 pts. SiF_4 in 24 hours (Davy).

Absorbed abundantly by HNO_3 + Aq. (Kühlmann, A. **39.** 319.)

Absorbed abundantly by alcohol, without separation of silicic acid, if the alcohol contains less than 8 % of water.

Sol. in conc. HF+Aq. Absorbed by ether. Sl. sol. in naphtha, and oil of turpentine.

Silicon hydrogen fluoride, H_2SiF_6.

See **Fluosilicic acid.**

Silicon fluoride *with* **MF.**

See **Fluosilicate, M.**

Silicon fluoride ammonia, SiF_4, $2NH_3$.

Decomp. by H_2O. (Davy.)

Silicon hydride, SiH_4.

Insol. in H_2O. Decomp. by KOH + Aq. Not changed by NH_4OH + Aq, H_2SO_4 + Aq, or HCl + Aq.

Silicon ***di*****iodide,** SiI_2.

Insol. in CS_2, $CHCl_3$, C_6H_6, and $SiCl_4$. (Friedel and Ladenburg, A. **203.** 247.)

Silicon ***tri*****iodide,** Si_2I_6.

Decomp. with H_2O even at 0°.

100 pts. CS_2 dissolve 19 pts. Si_2I_6 at 19°; 26 pts. Si_2I_6 at 27°. (Friedel and Ladenburg, Bull. Soc. (2) **12.** 92.)

$HSiI_3$. *See* **Silicoiodoform.**

Silicon ***tetra*****iodide,** SiI_4.

Decomp. by H_2O. Acts on alcohol and ether.

1 pt. CS_2 dissolves 2·2 pts. SiI_4 at 27°. (Friedel, A. **149.** 96.)

Silicon hydroxide, SiO_2, xH_2O.

See **Silicic acid.**

$Si_2H_2O_4$. *See* **Silicooxalic acid.**
$Si_2H_2O_3$. *See* **Silicoformic anhydride.**
$Si_4H_4O_3$. *See* **Silicone.**

Silicon nitride, Si_2N_3.

Insol. in all acids except HF.

HSi_2N_3. Sol. in HF, and rapidly in KOH + Aq. (Schützenberger, C. R. **92.** 1508.)

Silicon ***di*****oxide,** SiO_2.

See also **Silicic acid.**

(*a*) *Crystalline.* Min. *Quartz, Tridymite.*

Insol. in H_2O, and acids, except HF.

Sl. sol. in boiling K_2CO_3 + Aq, and KOH + Aq; see below.

Insol. in cold KOH + Aq; extremely slowly sol. in boiling KOH + Aq. (Fuchs.)

Sol. in HF with formation of SiF_4 and H_2O.

Insol. in sugar + Aq, contrary to assertion of Verdeil and Rissler. (Petzholdt, J. pr. **60.** 368.)

(*b*) *Amorphous.* Min. *Opal*, etc.

Insol. in H_2O, and acids except HF.

100 pts. H_2O containing CO_2 dissolve 0·078 pt. amorphous SiO_2 (Maschke); 0·0136 pt. (Struckmann).

100 pts. cold HCl + Aq of 1·088 sp. gr. dissolve 0·017 pt. SiO_2. (Struckmann.) 100 pts. HCl + Aq of 1·115 sp. gr. dissolve in the cold 0·009 pt. SiO_2, and 0·018 pt. on boiling. 100 pts. NH_4OH + Aq (containing 10 % NH_3) dissolve 0·017 pt. quartz and 0·38 pt. ignited SiO_2. (Pribram, Z. anal. **6.** 119.)

Sol. in boiling K_2CO_3 or Na_2CO_3 + Aq, separating out on cooling as a gelatinous mass. (Pfaff, Schw. J. **29.** 383.) The different forms of SiO_2 have different degrees of solubility in K_2CO_3 + Aq. Unignited amorphous SiO_2 from SiF_4 dissolves most readily, then come opal, ignited amorphous SiO_2, fused SiO_2, and tridymite; quartz powder is the most difficultly soluble. (Rose.) A similar behaviour is shown to KOH + Aq.

Opal is much more sol. in KOH + Aq than quartz, and hyalite is the least sol. of the varieties of opal. (Fuchs.)

Opal is easily sol. in KOH + Aq, even after ignition. (Schaffgotsch, Pogg. **68.** 147.)

Rammelsberg (Pogg. **112.** 177) made the following experiments on the solubility of SiO_2 in KOH + Aq. The KOH + Aq used contained 1 pt. KOH to 3 pts. H_2O. 1 pt. of the powdered mineral was boiled half an hour in a silver dish with such an amount of the KOH + Aq that 20 pts. KOH were present.

7·75 % of milky white quartz was dissolved by repeating the above process three times.

12·8-15 % of gray hornstone was dissolved by twice boiling; 2·43 % of moderately finely powdered agate of 2·661 sp. gr. was dissolved by once boiling; 9·7 % of unignited hyalite remained undissolved after thrice boiling; 21 % of ignited hyalite remained undissolved after thrice boiling; 7·21 % of semi-opal of 2·101 sp. gr. remained undissolved after thrice boiling; 18·5-19·2 % of impure semi-opal of 2·101 sp. gr. remained undissolved after thrice boiling; 79·9 % of chalcedony of 2·624 sp. gr. remained undissolved after thrice boiling; 6·12 % of chalcedony of 2·567 sp. gr. remained undissolved after fourth boiling; 14·4 % chrysophrase of 2·623 sp. gr. remained undissolved after once boiling; 49·41 % of chrysophrase of 2·635 sp. gr. remained undissolved after thrice boiling; 6·62 % of flint of 2·606 sp. gr. remained undissolved after twice boiling; 38·1 % of fire-opal of 2·625 sp. gr. remained undissolved after fourth boiling; 26·6 % of fire-opal of 2·625 sp. gr. remained undissolved after fifth boiling.

Silicon thorium oxide.

See **Silicate, thorium.**

Silicon zirconium oxide.

See **Silicate, zirconium.**

Silicon oxychloride, Si_2OCl_6.

Decomp. by H_2O and alcohol. Miscible with CS_2, $SiCl_4$, CCl_4, $CHCl_3$, or ether. (Friedel and Ladenburg, A. **147.** 355.)

$Si_4O_3Cl_{10}$; $Si_4O_4Cl_8$; $Si_8O_{10}Cl_{12}$; $(Si_2O_3Cl_2)_n$. $Si_4O_7Cl_2$. Sol. in above oxychlorides. (Troost and Hautefeuille, Bull. Soc. (2) **35.** 360.)

Silicon oxyfluorhydrin, $Si_2O_3\genfrac{}{}{0pt}{}{OH}{F}$.

(Landolt, A. Suppl. **4.** 27.)

Silicon selenide, $SiSe_2$.

Decomp. by H_2O or KOH + Aq. (Sabatier, C. R. **113.** 132.)

Silicon sulphide, SiS_2.

Sol. in H_2O with decomp. Acts on alcohol or ether in the cold. (Fremy, A. ch. (3) **38.** 314.)

SiS. Decomp. by H_2O; easily sol. in dil. alkalies. (Schützenberger, Bull. Soc. (2) **38.** 56.)

Silicone, $Si_4H_4O_3$.

Insol. in H_2O, but gives off hydrogen when warmed therewith. Not attacked by chlorine or nitric or sulphuric acids even on heating, but is gradually sol. in HF. Decomp. by alkalies, even by the most dil. NH_4OH+Aq, with greatest violence and evolution of heat and hydrogen gas. Insol. in alcohol, $SiCl_4$, PCl_3, or CS_2. (Wöhler, A. **127.** 257.)

Silicooxalic acid, $Si_2H_2O_4 = Si_2O_2(OH)_2$.

Decomp. by bases with evolution of hydrogen. Takes up HNO_3 to form compound, but not HCl or H_2SO_4. (Troost and Hautefeuille, A. ch. (5) **7.** 463.)

Silicophosphoric acid, SiO_2, P_2O_5.

Slowly decomp. by H_2O. Unchanged by alcohol. Exists also in two modifications which are not attacked by H_2O. (Hautefeuille and Margottet, C. R. **99.** 789.)

SiO_2, $2P_2O_5+4H_2O$. Decomp. by moist air. Sol. in H_2O at 0°, but decomp. by warming to ordinary temp. (Hautefeuille and Margottet, C. R. **104.** 56.)

Calcium silicophosphate.

See **Phosphate silicate, calcium.**

Silicostannic acid.

Calcium silicostannate, $Ca(Si,Sn)O_3$.

Not attacked by acids, $KHSO_4$, or alkalies + Aq. (Bourgeois, Bull. Soc. (2) **47.** 297.)

Silico*deci*tungstic acid, $H_8W_{10}SiO_{36}+3H_2O = 4H_2O, SiO_2, 10WO_3+3H_2O$.

Sometimes sol. in H_2O, but usually separates out gelatinous silica. (Marignac, A. ch. (4) **3.** 55.)

See also **Silico*duodeci*tungstic acid.**

Ammonium silico*deci*tungstate, $(NH_4)_8W_{10}SiO_{36}+8H_2O$.

Sol. in 4·5 pts. H_2O at 18°. Very sol. in hot H_2O. (Marignac, A. ch. (4) **3.** 59.)

$(NH_4)_6H_2W_{10}SiO_{36}+9H_2O$. (Marignac.)

Ammonium potassium ——, $(NH_4)_3K_4HSiW_{10}O_{36}+15H_2O$.

(Marignac.)

Barium ——, $Ba_4SiW_{10}O_{36}+22H_2O$.

Precipitate. Insol. in H_2O. (Marignac.)

Potassium ——, $K_8SiW_{10}O_{36}+17H_2O$.

Sol. in H_2O. (Marignac.)

$K_4H_4SiW_{10}O_{36}+8H_2O$. Sol. in H_2O. (Marignac.)

Potassium —— silicotungstate (?), $K_8SiW_{11}O_{39}+14H_2O$.

$K_4H_4SiW_{11}O_{39}+10H_2O$. (Marignac.)

Silver silico*deci*tungstate, $Ag_8W_{10}SiO_{36}+3H_2O$.

Not appreciably sol. in cold H_2O. (Marignac, A. ch. (4) **3.** 65.)

Silicotungstic acid or Silico*duodeci*tungstic acid, $H_8SiW_{12}O_{42}$.

$+29H_2O$. Efflorescent. Sol. in H_2O. Saturated solution at 18° contains 1 pt. crystallised acid to 0·104 pt. H_2O, and has 2·843 sp. gr. Melts in crystal H_2O. Easily sol. in absolute alcohol and anhydrous ether.

$+22H_2O$. Solubility as above.

100 pts. deliquesce with 13 pts. ether. To this mixture 20-25 pts. of ether can be added, but a further quantity no longer mixes with, but floats above the mixture. Ethereal solution is miscible with H_2O. Ether is taken up by a saturated aqueous solution with evolution of heat, until the volume has become doubled; more ether floats on the mixture. By warming the latter a liquid separates out which forms a layer between the two original layers. Alcoholic solution of the acid mixes with an equal vol. of ether, but on adding more ether a conc. ethereal solution separates as a syrupy layer. (Marignac, A. ch. (4) **3.** 10.)

See also **Tungstosilicic acid.**

Aluminum silicotungstate, $Al_4H_{12}(SiW_{12}O_{42})_3+87H_2O$.

Very sol. in H_2O. (Marignac.)

Aluminum ammonium ——, $Al_4(NH_4)_{18}(SiW_{12}O_{42})_3+75H_2O$.

Sol. in H_2O. (Marignac.)

Ammonium ——, $(NH_4)_8SiW_{12}O_{42}+16H_2O$.

Very sol. in hot H_2O. (Marignac, A. ch. (4) **3.** 17.)

$(NH_4)_4H_4SiW_{12}O_{42}+6H_2O$. Less soluble in H_2O than the preceding salt. (Marignac.)

Barium ——, $Ba_2H_4SiW_{12}O_{42}+14H_2O$.

Sol. in H_2O.

$+22H_2O$. Gradually efflorescent. (Marignac.)

Barium sodium ——, $Na_4Ba_2SiW_{12}O_{42}+28H_2O$.

H_2O gradually dissolves out sodium silicotungstate.

Cæsium ——, $Cs_8SiW_{12}O_{42}$.

100 pts. H_2O dissolve only 0·005 pt. at 20°; 0·52 pt. at 100°.

Completely insol. in alcohol, and HCl + Aq. Somewhat sol. in dil. NH_4OH+Aq. (Godeffroy, B. **9.** 1363.)

Calcium ——, $Ca_2H_4SiW_{12}O_{42}+22H_2O$.

Very sol in H_2O. (Marignac.)

Magnesium ——, $Mg_2H_4SiW_{12}O_{42}+16H_2O$.

Stable on the air. (Marignac.)

Mercurous ——, $Hg_8SiW_{12}O_{42}$.

Insol. in H_2O. Scarcely sol. in dil. HNO_3 + Aq. (Marignac, A. ch. (4) **3.** 43.)

Potassium ——, $K_8SiW_{12}O_{42}+14H_2O$.

Sol. in 10 pts. H_2O at 18°, and less than 3 pts. at 100°. (Marignac.)

$K_4H_4SiW_{12}O_{42}+16H_2O$. Sol. in 3 pts. H_2O at 20°.

$K_6H_{10}(SiW_{12}O_{42})_2+25H_2O$. Decomp. by dissolving in H_2O. (Marignac.)

Rubidium ——, $Rb_8SiW_{12}O_{42}$.

Sol. in 145-150 pts. H_2O at 20° and in 19-20 pts. at 100°. Insol. in alcohol; difficultly sol. in acidified, but extremely easily in ammoniacal H_2O. (Godeffroy, B. **9**. 1363.)

Silver ——, $Ag_4H_4SiW_{12}O_{42}+7H_2O$.

Very sl. sol. in H_2O; sol. in dil. HNO_3+Aq. (Marignac.)

Sodium ——, $Na_8SiW_{12}O_{42}+7H_2O$.

The saturated solution at 19° contains 0·21 pt. H_2O to 1 pt. of the salt dried at 100°, and has sp. gr. = 3·05. (Marignac.)

$Na_4H_4SiW_{12}O_{42}+11H_2O$. Stable on air.

$+18H_2O$. Efflorescent. (Marignac.)

$Na_2H_6SiW_{12}O_{42}+14H_2O$. Decomp. by dissolving in H_2O. (Marignac.)

Sodium —— nitrate, $3Na_4H_4SiW_{12}O_{42}, 4NaNO_3+39H_2O$.

Slightly deliquescent. (Marignac.)

Silver, Ag.

Not attacked by H_2O. Absolutely insol. in HCl or $HC_2H_3O_2+Aq$. (Lea, Sill. Am. J. **144**. 444.) Easily sol. in HNO_3+Aq on warming, if not too conc. Only a minute trace is dissolved in an hour by cold dil. HNO_3+Aq (1 pt. HNO_3+Aq of sp. gr. 1·40 : 10 pts. H_2O). (Lea.) Sol. in hot conc. H_2SO_4 with evolution of SO_2. Sl. sol. in dil. H_2SO_4+Aq (1 : 4), but with more dil. H_2SO_4+Aq the different forms of Ag behave differently. (Lea.)

Sol. in $HI+Aq$ at ordinary temperature. Sol. in $KI+Aq$ with access of air. Sol. in hot $KCN+Aq$. (Christomanos, Z. anal. **7**. 301.)

Slowly decomp. into AgCl by alkali chlorides $+Aq$; also by $CuCl_2$, etc. $+Aq$.

Somewhat sol. in NH_4OH+Aq in presence of O. (Lea, Sill. Am. J. **144**. 444.)

Sol. in $KMnO_4$ + dil. H_2SO_4+Aq. (Friedheim, B. **20**. 2554.)

Sol. in $Fe_2(SO_4)_3+Aq$, especially on heating, but completely insol. in $FeSO_4+Aq$. (Vogel.)

Allotropic forms—(α). Very sol. in H_2O. Solution is pptd. by saline solutions or almost any neutral substance. Alkali sulphates, nitrates, and citrates ppt. it in a sol. form, while $MgSO_4$, $CuSO_4$, $FeSO_4$, $NiSO_4$, $K_2Cr_2O_7$, $K_4Fe(CN)_6$, $Ba(NO_3)_2$, and even $AgNO_3+Aq$ ppt. it in an insol. form, which, however, may be made sol. again by treatment with many substances, as $Na_2B_4O_7$, K_2SO_4, or Na_2SO_4+Aq. $NaNO_2+Aq$ ppts. the Ag from its solution in a perfectly insol. form.

(β). The ppt. from aqueous solution by salts is sol. in NH_4OH+Aq. (Lea, Sill. Am. J. **137**. 476.)

Many other allotropic forms exist. (Lea.)

Pure colloidal silver is also sol. in alcohol. Schneider, B. **25**. 1164.)

Silver antimonide, Ag_2Sb or Ag_4Sb.

Min. *Discrasite*. Sol. in HNO_3+Aq.

Ag_3Sb. Insol. in $HCl+Aq$; decomp. by HNO_3+Aq. (Christofle.)

Silver azoimide, AgN_3.

Insol. in hot or cold H_2O or dil. acids; sol. in conc. mineral acids. Sol. in NH_4OH+Aq. (Curtius, B. **23**. 3023.)

Silver bromide, AgBr.

Insol. in H_2O, or H_2O acidulated with HNO_3, H_2SO_4, or $HC_2H_3O_2$ between 0° and 33°. If flocculent or pulverulent, it is sensibly sol. therein above 33°, but if granular only above 50°, and then very slightly. (Stas, A. ch. (5) **3**. 289.) Ag can be detected as AgBr in 10,000,000 pts. H_2O. (Stas.)

Calculated from the electrical conductivity of $AgBr+Aq$, AgBr is sol. in 1,971,658 pts. H_2O at 20·2°, and 775,400 pts. at 38°. (Holleman, Z. phys. Ch. **12**. 133.)

By same method Kohlrausch and Rose calculate that 1 l. H_2O dissolves 0·4 mg. AgBr at 18°. (Z. phys. Ch. **12**. 240.)

Boiling H_2O dissolves 0·000003502 of its weight of AgBr. HNO_3+Aq (1 % HNO_3) dissolves 0·00000543 of its weight of AgBr at 100° with sl. decomposition. The solution is pptd. by $AgNO_3+Aq$ or HBr (or MBr) $+Aq$, but not completely. 1 pt. of AgBr in solution requires 3 pts. of Br as MBr (or HBr), or of Ag as $AgNO_3$ in order to be wholly precipitated. (Stas.)

Not attacked by boiling HNO_3+Aq; sl. sol. in conc. HBr or $HCl+Aq$ (Löwig). Boiling conc. H_2SO_4 decomposes it (Balard), hardly acts on it (Dumas), dissolves a small quantity, which is repptd. by H_2O (Berzelius).

Very sl. sol. in dil., easily in conc. NH_4OH+Aq. 100 pts. NH_4OH+Aq (0·986 sp. gr.) dissolve 0·051 pt. AgBr (dried at 100°) at 80°, and about double that amount of freshly pptd. AgBr. (Pohl, W. A. B. **41**. 267.)

1 g. freshly pptd. AgBr is sol. in 250 ccm. 10 % NH_4OH+Aq, but insol. in an ammoniacal solution of AgCl. (Seiner, Pharm. J. Trans. (3) **14**. 1.)

1 g. AgBr dissolves in 8779·4 g. 5 % NH_4OH+Aq (sp. gr. = 0·998) at 12°, and in 288·5 g. 10 % NH_4OH+Aq (sp. gr. = 0·96) at 12°. (Longi, Gazz. ch. it. **13**. 87.)

Abundantly sol. in $Hg(NO_3)_2+Aq$. 100 ccm. H_2O containing 10 ccm. normal $Hg(NO_3)_2+Aq$ dissolve 0·0383 g. AgBr. (Stas.)

Sol. in conc. KBr or $NaBr+Aq$ (Löwig), but less than AgI in $KI+Aq$ (Field).

100 g. NaCl in conc. $NaCl+Aq$ dissolve 474 mg. AgBr at 15°; 100 g. NaCl in 21 % $NaCl+Aq$ dissolve 188 mg. AgBr at 15°; 100 g. KBr in conc. $KBr+Aq$ dissolve 3019 mg. AgBr at 15°; 95 g. NaCl + 10 g. KBr dissolve only 75 mg. AgBr at 15°. (Schierholz, W. A. B. **101, 2b**. 4.)

Sol. in hot NH_4Cl+Aq. Very sl. sol. in NH_4 carbonate, sulphate, or succinate $+Aq$, and still less in nitrate. (Wittstein.) Not very easily sol. in $Na_2S_2O_3+Aq$ when suspended in much H_2O, and is separated out again by $KBr+Aq$. (Field, C. N. **3**. 17.)

Difficultly sol. in hot conc. $AgNO_3+Aq$. (Risse, A. **111**. 39.)

Sol. in $KCN+Aq$. Sl. sol. in conc. KCl, KBr, $NaCl$, $NaBr$, NH_4Cl, or NH_4Br+Aq; but insol. when dilute.

Traces only dissolve in alkali nitrates $+Aq$. (Fresenius, Quant. Anal.)

In a solution of $NaC_2H_3O_2+Aq$, containing 10 ccm. of sat. $NaC_2H_3O_2+Aq$ at 15° and 20 ccm. normal $HC_2H_3O_2+Aq$ mixed with 970 ccm. H_2O, about double the amt. of flocculent AgBr is dissolved in the cold that is dissolved by boiling H_2O from granular AgBr. This solution required 3 pts. of Ag or Br to ppt. the AgBr in solution. Pulverulent or granular AgBr are wholly insol. in dil. or conc. acetates $+Aq$. (Stas.)

Sol. in $Hg(C_2H_3O_2)_2+Aq$.

100 ccm. H_2O containing 10 % of normal $Hg(C_2H_3O_2)_2+Aq$ dissolves 0·0122 g. AgBr at 20°.

Min. *Bromyrite*, *Bromite*.

Silver bromide ammonia.

Known only in solution in NH_4OH+Aq, which becomes turbid on addition of H_2O or on evaporation, with pptn. of AgBr.

Silver carbide, Ag_4C.

(Gay-Lussac.)

Ag_2C (?). Sol. in HNO_3+Aq with residue of C. (Liebig, A. **38**. 129.)

Ag_2C_2. Sol. in HNO_3+Aq with residue of C. (Regnault, A. **19**. 153.)

Argentous chloride, Ag_2Cl.

Obtained in a pure state by Guntz (C. R. **112**. 861). Dil. HNO_3+Aq does not attack; but warm conc. HNO_3+Aq decomp. Easily sol. in $KCN+Aq$. (Guntz, C. R. **112**. 1212.)

The following data are for a more or less impure Ag_2Cl.

Boiling conc. $HCl+Aq$, $NaCl+Aq$, or NH_4OH+Aq dissolve out AgCl, and leave Ag. (Scheele, Wetzlar, Dulk, Wöhler.)

According to Berthollet, wholly sol. in NH_4OH+Aq.

Sol. for the most part in NH_4OH+Aq, and the residue is sol. in HNO_3+Aq ($=Ag+AgCl$). (v. Bibra, B. **7**. 741.)

Silver chloride, AgCl.

Nearly insol. in H_2O.

When AgCl is left in contact for some hours with pure H_2O at 20-22°, and especially at 75°, traces go into solution; more Cl is dissolved than Ag. When 1 pt. Ag is pptd. as AgCl in presence of 1 million pts. H_2O a slight bluish milkiness is observed; but in order to have a distinct ppt. 4 pts. Ag should be present.

Dil. HNO_3+Aq does not increase the solubility of AgCl, but AgCl is not absolutely insol. in stronger HNO_3+Aq. (Mulder.)

1 pt. $AgNO_3$, when mixed with $HCl+Aq$ in presence of 120,000 (Pfaff), 240,000 (Harting), pts. H_2O, causes an opalescence.

1 pt. Ag gives a slight turbidity with $HCl+Aq$ in presence of 200,000 pts. H_2O, a scarcely opalescent cloudiness with 400,000 pts. H_2O, and the same after the lapse of 15 minutes in presence of 800,000 pts. H_2O. (Lassaigne.)

1 pt. Ag can be detected as AgCl in 1 million parts H_2O at ordinary temp., but not in 2 million parts. In $NaNO_3+Aq$ containing 0·79 pt. $NaNO_3$ in 200,000 pts. H_2O 1 pt. Ag can be detected as AgCl. This dissolves at 75°, and is visible again on cooling.

If the same liquid contains 1574 pts. $NaNO_3$, the AgCl remains in solution after cooling.

In 100 ccm. H_2O containing 0·787 g. $NaNO_3$, 13 drops of NaCl and silver solution, each drop of which contains 0·05 mg. Ag, cause a precipitate at 5°, 20 drops at 15-17°, 60 drops at 45-55°.

AgCl is somewhat less sol. in HNO_3+Aq than in $NaNO_3+Aq$ when the amount of H_2O remains the same.

Therefore, if HCl is used instead of NaCl, about $\frac{1}{7}$ less AgCl remains in solution.

In 100,000 pts. of H_2O, which contain HNO_3 and an amount of HCl corresponding to the amount of Ag salt, 1·596 pts. AgCl dissolve at 25°. The solution is precipitated by either $AgNO_3$ or HCl. (Mulder, Silber Probirmethode, Leipzig, **1859**. 62.)

(For further older data, see Storer's Dictionary.)

White flaky AgCl is appreciably sol. in hot H_2O, 1000 ccm. boiling H_2O dissolving about 2 mg. AgCl. Far less sol. in H_2O containing $AgNO_3$, being practically insol. in H_2O containing 0·1 g. $AgNO_3$ in a litre. Solubility is also diminished one-half by addition of HCl. (Cooke, Sill. Am. J. (3) **21**. 220.)

Solubility in H_2O rapidly diminishes as the temp. falls. (Cooke, *l.c.*)

Not completely insol. in H_2O. According to Stas (C. R. **73**. 998) there are four modifications: (1) gelatinous; (2) cheesy-flocculent; (3) pulverulent; (4) granular, crystalline, or fused. (4) is almost absolutely insol. in H_2O at the ordinary temp., but the solubility increases with the temp., and is considerable at 100°; (2), which is formed by the precipitation of a cold dilute Ag solution, has the greatest solubility in pure H_2O, and it changes its solubility by standing, or if made pulverulent by shaking with H_2O; (3) is also sol. in H_2O; the solution of (2) or (3) in pure H_2O, or H_2O acidified with HNO_3, is precipitated by $AgNO_3$ or $NaCl+Aq$.

In order to ppt. 1 pt. AgCl in above solution 3 pts. of Cl as chloride or Ag as nitrate are necessary; the pptn. is then complete.

Solubility of granular variety in boiling H_2O is proportionately large, and pptn. is brought about by 3 pts. Cl or Ag as above, but the pptn. in this case is not complete.

The salts formed simultaneously with the AgCl have no influence on the solubility of the AgCl. Presence of HNO_3 does not increase the solubility of (2), but has that effect on (3) in proportion to the amt. of HNO_3 present. (Stas, C. R. **73**. 998.)

Further determinations by Stas are as follows:—

Between 0 and 30° granular AgCl is insol. in pure H_2O, or H_2O acidulated with HNO_3.

Between 0° and 30° the flocculent and pulverulent forms of AgCl dissolve without alteration in pure H_2O, in acidulated H_2O, in alkali acetates $+Aq$, and in $Hg(C_2H_3O_2)_2+Aq$ containing an alkali acetate. Their degree of solubility is a function of the state of the chloride, of the temp., and of the nature and quantity of the solvent within these limits of temp. (0°-30°). These solvents, if they contain either Ag in the state of an Ag salt, or Cl as chloride or HCl in an amount *three times* that which they can dissolve as AgCl, exercise no solvent action on any of the modifications of AgCl. And reciprocally sat. AgCl+Aq is pptd. instantly by a decinormal solution of $AgNO_3$ or MCl (or HCl). The AgCl is wholly pptd. when the quantity of the Ag or Cl thus added is equal to three times the quantity of the Ag or Cl dissolved as AgCl.

Between 50° and 100°, however, decinormal solutions of Ag or chlorides which cause instant ppts. in solutions sat. with any of the modifications of AgCl, do not eliminate all the dissolved AgCl. At 100°, they only ppt. 60 % of the amt. dissolved. (Stas, A. ch. (5) **3**. 323.)

Calculated from electrical conductivity of AgCl+Aq, AgCl is sol. in 715,800 pts. H_2O at 13·8°, and 384,100 pts. at 26·5°. (Holleman, Z. phys. Ch. **12**. 132.)

Calculated in the same way, 1 l. H_2O dissolves 0·76 mg. at 2°; 0·97 mg. at 10°; 1·52 mg. at 18°; 2·24 mg. at 26°; 3·03 mg. at 34°; 4·05 mg. at 42°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 242.)

Sol. in conc. HCl+Aq, and also when not very conc.; thus the solution of 1 pt. $AgNO_3$+Aq in 15,000 pts. H_2O is clouded by a little HCl+Aq, but clears up by the addition of more. (Reinsch, J. pr. **13**. 133.)

1 pt. AgCl dissolves in 200 pts. conc. HCl+Aq and in 600 pts. HCl+Aq diluted with 2 pts. H_2O. (Pierre, J. Pharm. (3) **12**. 237.)

Somewhat sol. in hot alcohol, to which HCl has been added, but is precipitated on cooling. (Erdmann, J. pr. **19**. 341.)

100 pts. sat. HCl+Aq (sp. gr. 1·165) dissolve 0·2980 pt. AgCl, or AgCl is sol. in 336 pts. HCl+Aq at ord. temp.; 100 pts. HCl+Aq (sp. gr. 1·165) at b.-pt. dissolve 0·56 g. AgCl, or AgCl is sol. in 178 pts. HCl+Aq.

Solubility of AgCl in dil. HCl+Aq. 100 ccm. HCl+Aq (sp. gr. 1·165), to which the given amt. H_2O has been added, dissolve g. AgCl.

ccm. HCl.	ccm. H_2O.	g. AgCl.	Pts. HCl which dissolve 1 pt. AgCl.
100	10	0·056	1785
100	20	0·018	5555
100	30	0·0089	11,235
100	50	0·0035	18,571

(Vogel, N. Rep. Pharm. **23**. 335.)

If HCl is added to a solution in which $\frac{1}{1000000}$ pt. Ag is suspended, the milkiness disappears. Solubility in HCl+Aq increases with the temp., the AgCl separating out on cooling. (Mulder.)

Sl. sol. in conc. HBr+Aq. (Löwig.)

Insol. in HNO_3+Aq. (Wackenroder.)

Entirely unacted upon by HNO_3 of 1·43 sp. gr. (Wurtz, Am. J. Sci. (2) **25**. 382.)

Solubility in dil. HNO_3+Aq is the same as solubility in H_2O, *i.e.* $\frac{1}{2000000}$ pt. of Ag cannot be detected in H_2O with or without HNO_3, but $\frac{1}{1000000}$ pt. can be detected in both cases. (Mulder.)

1 pt. Ag in the form of AgCl dissolves at 25° in 83,000 pts. H_2O containing free HNO_3 and 0·33 pt. of HCl. (Mulder, p. 87.)

100,000 pts. conc. HNO_3+Aq dissolve about 2 pts. AgCl, and solubility is not sensibly affected by lower nitrogen oxides. (Thorpe, Chem. Soc. (2) **10**. 453.)

Insol. in cold conc. H_2SO_4, but on boiling is in part decomp. and in part dissolved, and does not separate on cooling.

AgCl is not more sol. in dil. H_2SO_4+Aq than in dil. HNO_3+Aq.

Unacted upon by cold H_2SO_3+Aq, and but slightly decomp. on heating. (Vogel.)

Abundantly sol. in H_2PtCl_4+Aq without decomp. (Birnbaum, Z. Ch. **1867**. 520.)

Insol. in cold dil. caustic alkalies+Aq, but decomp. by hot conc. solutions. (Gregory.)

Decomp. by K_2CO_3+Aq.

Sl. sol. in cold K_2CO_3+Aq.

Easily sol. even in dil. NH_4OH+Aq.

1 pt. AgCl dissolves in 1288 pts. NH_4OH+Aq of 0·89 sp. gr. (Wallace and Lamont, Chem. Gaz. **1859**. 137.)

100 pts. NH_4OH+Aq of 0·986 sp. gr. dissolve at 80° 1·492 pts. AgCl, dried at 100°. (Pohl, W. A. B. **41**. 627.)

1 l. NH_4OH+Aq of 0·949 sp. gr. dissolves 51·6 g. Ag as freshly precipitated AgCl, and 47·6 g. when diluted with 1 l. H_2O.

1 l. NH_4OH+Aq of 0·924 sp. gr. dissolves 58 g. Ag as freshly precipitated AgCl; 1 l. NH_4OH+Aq of 0·899 sp. gr. dissolves 49·6 g.; 0·5 l. NH_4OH+Aq (of 0·049 sp. gr.)+0·5 l. saturated NaCl+Aq dissolves 20·8 g.; 0·5 l. NH_4OH+Aq (of 0·949 sp. gr.)+0·5 l. saturated KCl+Aq dissolves 20·4 g.; 0·5 l. NH_4OH+Aq (of 0·949 sp. gr.)+0·5 l. saturated NH_4Cl+Aq dissolves 22·4 g. Ag as freshly pptd. AgCl. (Millon and Commaille, C. R. **56**. 309.)

1 g. AgCl dissolves in 428·64 g. 5 % NH_4OH+Aq (sp. gr. 0·998) at 12°; 1 g. AgCl dissolves in 12·76 g. 10 % NH_4OH+Aq (sp. gr. 0·96) at 18°. (Longi, Gazz. ch. it. **13**. 87.)

1 g. freshly pptd. AgCl is sol. in 17 ccm. 10 % NH_4OH+Aq. Solubility is diminished by presence of AgBr. (Senier, Pharm. J. Trans. (3) **14**. 1.)

Sol. in $NaNO_3$, KNO_3, $Ca(NO_3)_2$, $Mg(NO_3)_2$, and NH_4NO_3+Aq; sl. sol. at ord. temp., but solubility is much increased by heat.

Solubility in $NaNO_3$+Aq at 15-20°.

ccm. H_2O	g. $NaNO_3$	mg. AgCl dissolved
100	0·787	1·33
200	0·787	1·93
300	2·361	3·99
100	2·787	2·53

Solubility increases with ascending temp.

Temp.	ccm. H_2O	g. $NaNO_3$	mg. AgCl dissolved
5°	100	0·787	0·86
15-17°	100	0·787	1·33
18°	100	0·787	1·46
30°	100	0·787	2·33
45-55°	100	0·787	3·99

(Mulder.)

At 25° 100,000 pts. H_2O containing a little free HNO_3 and 0·787 g. $NaNO_3$ dissolve 2·128 mg. AgCl. By adding 2 g. more $NaNO_3$ to above solution 2·5269 mg. ($\frac{1}{5}$ more) AgCl are dissolved. (Mulder.)

$Hg(NO_3)_2$+Aq dissolves considerable quantities of AgCl, but the other nitrates do not. (Mulder.)

Much more sol. in hot than in cold $Hg(NO_3)_2$+Aq, and much more sol. therein than in NH_4NO_3+Aq. NaCl ppts. AgCl from this solution; much less sol. therein in presence of $NaC_2H_3O_2$ or NH_4OH+Aq. AgCl is pptd. from above solution by $NaC_2H_3O_2$+Aq. (Mulder.)

Sol. in $Hg(NO_3)_2$+Aq (Wackenroder, A. **41**. 317); in considerable amount (Liebig, A. **81**. 128); and is precipitated by HCl, NH_4Cl, NaCl, $KC_2H_3O_2$ (Debray, C. R. **70**. 849); incompletely precipitated by $AgNO_3$ and not by HNO_3 (Wackenroder).

Imperfectly sol. in $AgNO_3$+Aq. (Wackenroder.)

Conc. $AgNO_3$+Aq dissolves AgCl perceptibly.

Less sol. in $AgNO_3$+Aq than AgBr. (Risse, A. **111**. 39.)

Insol. in moderately dil. $Pb(C_2H_3O_2)_2$+Aq.

Not sol. to appreciable extent in $Cu(NO_3)_2$, $Fe_2(NO_3)_6$, $Mn(NO_3)_2$, $Co(NO_3)_2$, $Zn(NO_3)_2$, or $Ni(NO_3)_2$+Aq; insol. or exceedingly sl. sol. in $Pb(NO_3)_2$+Aq. (Mulder.)

Insol. in Na_2SO_4+Aq.

Easily sol. in $Na_2S_2O_3$ or KCN+Aq.

When freshly pptd. very sol. in solutions of soluble thiosulphates, and especially in conc. $Na_2S_2O_3$+Aq, which dissolves AgCl almost as readily as H_2O dissolves sugar. $K_2S_2O_3$+Aq, even when very dil., also dissolves AgCl, also SrS_2O_3+Aq. (Herschel, **1819**.)

Sol. in $KAsO_2$+Aq. (Reynoso.)

Easily (Brett), difficultly (Wittstein), sol. in NH_4Cl+Aq, but not in other NH_4 salts.

Sl. sol. in conc. KCl+Aq, NaCl+Aq, and certain other chlorides.

NaCl, KCl, NH_4Cl, $CaCl_2$, $ZnCl_2$+Aq, etc., dissolve appreciable quantities of AgCl, especially if hot and concentrated, but it separates out for the most part on cooling.

Sol. in solutions of all the metallic chlorides which are sol. in H_2O, thus NaCl, KCl, $CaCl_2$, $SrCl_2$, and $BaCl_2$+Aq all dissolve AgCl, especially if hot. $MgCl_2$, NH_4Cl, and $HgCl_2$ (least) also dissolve AgCl. (Mulder.)

Sol. in conc. $CaCl_2$+Aq. (Wetzlar.)

Sol. in roseocobaltic chloride+Aq. (Gibbs and Genth.)

Insol. in $SnCl_4$, $HgCl_2$, $CuCl_2$, $ZnCl_2$, $CdCl_2$, $NiCl_2$, or $CoCl_2$+Aq. (Vogel.)

Solubility of AgCl in sat. solutions of chlorides at ordinary temperatures.

Salt	100 pts. sat. solution dissolve pts. AgCl	Pts. solution required to dissolve 1 pt. AgCl
$BaCl_2$ . . .	0·0143	6993
$SrCl_2$ . . .	0·0884	1185
$CaCl_2$ . . .	0·0930	1075
NaCl . . .	0·0950	1050
KCl. . . .	0·0475	2122
NH_4Cl . .	0·1575	634
$MgCl_2$ . . .	0·1710	584
HCl . . .	0·2980	336

(Vogel, N. Rep. Pharm. **23**. 335.)

Experiments by Hahn give different results from those of Vogel as follows:—

Solubility in various salts+Aq.

Salt	% salt	Sat. at t°	% AgCl
KCl. . . .	24·95	19·6	0·0776
NaCl . . .	25·96	,,	0·1053
NH_4Cl . . .	28·45	24·5	0·3397
$CaCl_2$ . . .	41·26	,,	0·5713
$MgCl_2$ . . .	36·35	,,	0·5313
$BaCl_2$ . . .	27·32	,,	0·0570
$FeCl_2$ . . .	...	...	0·1686
$FeCl_3$ . . .	...	...	0·0058
$MnCl_2$ . . .	...	24·5	0·1996
$ZnCl_2$ . . .	...	...	0·0134
$CuCl_2$ . . .	...	24·5	0·0532
$PbCl_2$ . . .	...	,,	0·0000

(Hahn, Wyandotte Silver Smelting Works, **1877**.)

Solubility of AgCl in alkali chlorides+Aq.

At 15°, 100 g. NaCl in 280 ccm. H_2O dissolve 485 mg. AgCl; 100 g. KCl in 300 ccm. H_2O dissolve 334 mg.; 100 g. NH_4Cl in 280 ccm. H_2O dissolve 1051 mg.

The solubility decreases with dilution rapidly at first until about an equal vol. of H_2O has been added, and then much more slowly to a minimum quantity, when the dilution is 1:10 for NaCl and KCl, and 1:20 for NH_4Cl.

100 g. NaCl in 280 ccm. H_2O dissolve 2170 mg. AgCl at 109°; 100 g. NH_4Cl in 280 ccm. H_2O dissolve 4000 mg. AgCl at 110°; 100 g. NaCl in 620 ccm. H_2O (14% solution) dissolve 15 mg. AgCl at 15°, and 774 mg. at 104°. (Schierholz, W. A. B. **101, 2b.** 4.)

10 ccm. normal $Hg(C_2H_3O_2)_2$+Aq containing 0·1 g. Hg dissolve 0·01892 g. AgCl at 15°. (Stas.)

100 ccm. of a solution of a mixture of Na and Hg acetates dissolve 0·00175 g. AgCl. (Stas, A. ch. (5) **3**. 145.)

Perceptibly sol. on warming with solution of tartaric acid, but nearly the whole is deposited on cooling.

As sol. in coniine+Aq as in NH_4OH+Aq. (Blyth, Chem. Soc. **1.** 350.)

Sol. in methylamine+Aq. (Wurtz, A. ch. (3) **30.** 453.)

Sol. in amylamine+Aq, but less than in NH_4OH+Aq.

Sol. in caprylamine+Aq.

Sol. in sinamine, and thiosinamine+Aq.

Min. *Cerargyrite.*

Silver chloride ammonia, $AgCl, 3NH_3$.

More easily decomp. than $2AgCl, 3NH_3$.

$AgCl, 2NH_3$. Decomp. by H_2O. (Terreil, A. Phys. Beibl. **7.** 149.)

$2AgCl, 3NH_3$. Decomp. on air and in H_2O to AgCl. Sol. in conc. NH_4OH+Aq, from which it can be crystallised. (Rose.)

Insol. in alcohol. (Bodländer, Z. phys. Ch. **9.** 730.)

Silver chlorobromoiodides.

(Rodwell, Proc. Roy. Soc. **25.** 292.)

Silver *sub*fluoride (Argentous fluoride), Ag_2F.

Decomp. by H_2O into Ag and AgF. (Guntz, C. R. **110.** 1337.)

Silver fluoride, AgF.

Extremely deliquescent. (Gore.)

Sol. in 0·55 pt. H_2O at 15·5° with evolution of heat. Sp. gr. of sat. solution at 15·5°=2·61. (Gore.)

$+H_2O$. (Marignac.)

$+2H_2O$. Extremely deliquescent. (Pfaundler, J. B. **1862.** 86.)

Silver hydrogen fluoride.

Deliquescent, and very sol. in H_2O. (Gore.)

Silver stannic fluoride.

See **Fluostannate, silver.**

Silver tungstyl fluoride.

See **Fluoxytungstate, silver.**

Silver, fulminating.

See **Silver nitride.**

Argentous hydroxide, $Ag_4O_2H_2$.

Sol. in H_2O. Known only in solution. (Weltzien, A. **142.** 105.)

Silver hydroxide, AgOH.

Decomp. into Ag_2O and H_2O above −40°.

Argentous iodide, Ag_2I.

(Guntz, C. R. **112.** 861.)

Silver iodide, AgI.

Insol. in H_2O.

Calculated from electrical conductivity of AgI+Aq, AgI is sol. in 1,074,040 pts. H_2O at 28·4°, and 420,260 pts. at 40°. (Holleman, Z. phys. Ch. **12.** 130.)

1 l. H_2O dissolves 0·1 mg. AgI at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Insol. in dil. HNO_3+Aq or H_3PO_4+Aq. Decomp. by hot. conc. HNO_3+Aq or H_2SO_4. Easily sol. in conc. HI+Aq.

1 pt. AgI dissolves in 2510 pts. NH_4OH+Aq of 0·96 sp. gr. (Martini, Schw. J. **56.** 154); in 2493 pts. of 0·89 sp. gr. (Wallace and Lamont, Ch. Gaz. **1859.** 137).

1 g. AgI dissolves in 26,300 g. 10 % NH_4OH+Aq (sp. gr.=0·96) at 12°. Insol. in 5 % NH_4OH+Aq. (Longi, Gazz. ch. it. **13.** 87.)

Sol. in conc. KI+Aq, from which it is precipitated by H_2O. (Field, C. N. **3.** 17.)

According to Field, insol. in cold conc. KCl or NaCl+Aq, and only in traces on boiling, and separates out on cooling.

100 g. NaCl in conc. NaCl+Aq dissolve 0·95 mg. AgI at 15°; 100 g. NH_4Cl in conc. NH_4Cl+Aq dissolve 2·9 mg. AgI at 15°; 95 g. NaCl+10 g. KBr in conc. solution dissolve 1·2 mg. AgI at 15°; 100 g. KBr+225 g. H_2O dissolve 430 mg. AgI at 15°; 100 g. KBr in conc. KBr+Aq dissolve 525 mg. AgI at 15°; 100 g. KI+69 g. H_2O dissolve 89·8 g. AgI at 15°; 100 g. KI+92 g. H_2O dissolve 54·0 g. AgI at 15°; 100 g. KI+366 g. H_2O dissolve 7·25 g. AgI at 15°. (Schierholz, W. A. B. **101, 2b.** 4.)

Sl. sol. in $Na_2S_2O_3$+Aq when suspended in much H_2O, but separates again on addition of KI+Aq. (Field.)

100 pts. of $AgNO_3$+Aq sat. at 11° dissolve 2·3 pts. AgI in the cold, and 12·3 pts. on boiling. (Schnauss.)

Sol. in hot $Hg(NO_3)_2$+Aq, from which it crystallises on cooling.

Sol. in KCN+Aq.

Traces are dissolved by alkali nitrates+Aq. Easily sol. in hot KOH+Aq, from which it is pptd. by H_2O or alcohol. Not decomp. by boiling KOH+Aq. (Vogel, N. Rep. Pharm. **20.** 129.)

KI gives a ppt. with $AgNO_3$ in presence of 30,000 pts. H_2O. (Harting.)

Min. *Iodyrite.*

Silver hydrogen iodide, $3AgI, HI+7H_2O$.

(Berthelot, C. R. **91.** 1024.)

Silver iodide ammonia, $AgI, 2NH_3$.

(Terreil, C. R. **98.** 1279.)

$2AgI, NH_3$. (Rammelsberg, Pogg. **48.** 170.)

Composition is AgI, NH_3. (Longi, Gazz. ch. it. **13.** 86.)

Silver nitride, Ag_3N.

Berthollet's "knallsilber." Very explosive. Insol. in H_2O. Sol. in KCN+Aq. Slowly sol. in NH_4OH+Aq. (Raschig, A. **233.** 93.)

Argentous oxide, Ag_4O.

Insol. in H_2O. Decomp. by acids into argentic oxide and silver. Insol. in NH_4OH+Aq or $HC_2H_3O_2$. (v. der Pfordten, B. **20.** 1458.)

Contains H, and is a hydroxide $Ag_4.H_2O$. (v. der Pfordten, B. **21.** 2288.)

The above substance is a mixture, according to Friedheim (B. **20.** 2557.)

Silver oxide, Ag_2O.

Somewhat sol. in H_2O. (Bucholz.)

Sol. in 3000 pts. H_2O (Bineau, C. R. **41.** 509); sol. in 96 pts. H_2O (Abl).

Sol. in acids, NH_4OH, and $(NH_4)_2CO_3$+Aq. Decomp. by alkali chlorides, bromides, and iodides+Aq. Sol. in alkali cyanides, and thiosulphates + Aq. Sl. sol. in nitrates + Aq; insol. in sulphates + Aq. When freshly pptd., sol. in NH_4SCN + Aq. Sl. sol. in NH_4NO_3 + Aq. Abundantly sol. in $Ba(NO_3)_2$ + Aq without pptn. of BaO_2H_2. Sol. in boiling $Mn(NO_3)_2$, $Ni(NO_3)_2$, $Co(NO_3)_2$, $Cu(NO_3)_2$, and $Ce_2(NO_3)_6$ + Aq with pptn. of oxides. (Persoz.)

Insol. in KOH, and NaOH + Aq. Sl. sol. in BaO_2H_2 + Aq. (Berzelius (?).)

Sl. sol. in amylamine + Aq, easily in methylamine + Aq (Wurtz, A. ch. **30**. 453); also in ethylamine, and thiosinamine + Aq.

Silver *per***oxide**, Ag_2O_2.

Sol. in conc. H_2SO_4 (Rose), and in pure HNO_3 + Aq without decomp. Sol. in NH_4OH + Aq. (Schönbein, J. pr. **41**. 321.)

Silver oxide ammonia.

See **Silver nitride.**

Silver oxyfluoride, AgF, AgOH.

Decomp. by H_2O with separation of Ag_2O. (Pfaundler.)

Silver phosphide, Ag_4P_6.

Insol. in HCl + Aq; easily sol. in HNO_3 + Aq. (Schrötter, J. B. **1849**. 247.)

Ag_3P (?). (Fresenius and Neubauer, Z. anal. **1**. 340.)

Silver phosphoselenide, Ag_2Se, P_2Se.

Insol. in H_2O or HCl + Aq. Sol. in HNO_3 + Aq. Insol. in cold, decomp. by hot alkalies + Aq. (Hahn, J. pr. **93**. 436.)

$2Ag_2Se$, P_2Se_3. Insol. in H_2O, HCl, or HNO_3 + Aq; slowly sol. in red fuming HNO_3. (Hahn, J. pr. **93**. 440.)

$2Ag_2Se$, P_2Se_5. Sol. only in fuming HNO_3. (Hahn.)

Silver phosphosulphide, $2Ag_2S$, P_2S.

Ag_2S, P_2S. (Berzelius, A. **46**. 254.)

$2Ag_2S$, P_2S_3. Easily sol. in HNO_3 + Aq without separation of P. (Berzelius.)

$Ag_4P_2S_7$. (Berzelius.)

Silver selenide, Ag_2Se.

Sol. in boiling HNO_3 + Aq as Ag_2SeO_3, which separates out by dilution with H_2O. (Berzelius.)

Insol. in $Hg_2(NO_3)_2$ + Aq. (Wackenroder, A. **41**. 327.)

Min. *Naumannite*. Insol. in dil., but sol. in conc. HNO_3 + Aq.

Argentous sulphide, Ag_4S.

Easily sol. in warm dil. HNO_3 + Aq, and in conc. H_2SO_4 without separation of S. Sol. in conc. KCN + Aq. (v. der Pfordten, B. **20**. 1458; Guntz, C. R. **112**. 861.)

Silver sulphide, Ag_2S.

Insol. in H_2O. Sol. in conc. HNO_3 + Aq with separation of S. Sol. in hot conc. HCl + Aq. Not decomp. by $CuCl_2$ + Aq, but by $CuCl_2$ + NaCl + Aq. Insol. in NH_4OH + Aq. Insol. in H_2SO_3 + Aq, or in $Hg(NO_3)_2$ + Aq.

Insol. in H_2O, dil. acids, alkalies, and alkali sulphides + Aq. (Fresenius.)

Sol. in KCN + Aq. (Hahn, C. C. **1870**. 240.)

Difficultly sol. in KCN + Aq; less difficultly if Ag_2S is pptd. from a very dil. solution. Amt. of KCN present also has influence on the solubility. Ag_2S dissolved in conc. KCN + Aq separates out on dilution. (Béchamp. J. pr. **60**. 64.)

Insol. in NH_4Cl or NH_4NO_3 + Aq. (Brett.)

Min. *Argentite*. *Acanthite*. Sol. in conc. HNO_3 + Aq with separation of S.

Sol. in citric acid + Aq with addition of KNO_3. (Bolton, C. N. **37**. 48.)

Silver zinc sulphide, Ag_2S, 3ZnS.

(Schneider, J. pr. (2) **8**. 29.)

Silver telluride, Ag_2Te.

Min. *Hessite*. Sol. in warm HNO_3 + Aq.

Sodium, Na_2.

Violently decomposes H_2O, alcohol, etc. Insol. in hydrocarbons. Easily sol. in acids with violent action. Sol. in liquid NH_3.

Sodium amide, $NaNH_2$.

Decomp. by H_2O and alcohol.

Sodium amidochloride, Na_2NH_2Cl.

Sol. in H_2O with decomp. (Joannis, C. R. **112**. 392.)

Sodium azoimide, NaN_3.

Not hygroscopic. Sol. in H_2O. Insol. in alcohol and ether. (Curtius, B. **24**. 3344.)

Sodium bromide, NaBr, and $+2H_2O$.

Not deliquescent. Solubility in H_2O differs according as NaBr or NaBr + $2H_2O$ is used. The following data for anhydrous NaBr were found.

Pts. NaBr dissolved by 100 pts. H_2O at t°.

t°	Pts. NaBr	t°	Pts. NaBr	t°	Pts. NaBr
44·1	115·6	74·5	118·4	97·2	119·9
51·5	116·2	80·5	118·6	100·3	120·6
55·1	116·8	86·0	118·8	110·6	122·7
60·3	117·0	90·5	119·7	114·3	124·0
64·5	117·3	...	...	...	...

Solubility is represented by a straight line of the formula $S = 110{\cdot}34 + 0{\cdot}1075t$.

Below 50° the salt usually crystallises with $2H_2O$, of which the solubility in 100 pts. H_2O was found to be as follows:

t°	Pts. NaBr	t°	Pts. NaBr	t°	Pts. NaBr
−21	71·1	+5	82·0	30	97·3
−20	71·4	+10	84·5	35	101·3
−15	73·1	+15	87·3	40	105·8
−10	75·1	+20	90·3	45	110·6
−5	77·1	+25	93·8	50	116·0
0	79·5	...	...	...	...

(Coppet, A. ch. (5) **30**. 420.)

If solubility S = pts. NaBr in 100 pts. solution, $S = 40{\cdot}0 + 0{\cdot}1746t$ from −20° to +40°;

S=52·3+0·0125t from 50° to 150°. (Étard, C. R. **98.** 1432.)

100 pts. H_2O dissolve: at 0°, 77·5 pts. NaBr; at 20°, 88·4 pts.; at 40°, 104·2 pts.; at 60°, 111·1 pts.; at 80°, 112·4 pts.; at 100°, 114·9 pts. (Kremers.)

Sat. solution boils at 121°. (Kremers, Pogg. **97.** 14.)

Sp. gr. of NaBr+Aq at 19·5° containing:

5	10	15	20	25	% NaBr,
1·040	1·080	1·125	1·174	1·226	
30	35	40	45	50	% NaBr.
1·281	1·344	1·410	1·483	1·565	

(Gerlach, Z. anal. **8.** 285.)

100 pts. NaBr+Aq sat. at 18-19° contain 46·05 pts. NaBr; 100 pts. NaBr+NaCl+Aq sat. at 18-19° contain 46·59 pts. of the two salts; 100 pts. NaBr+NaI+Aq sat. at 18-19° contain 63·15 pts. of the two salts; 100 pts. NaBr+NaCl+NaI+Aq sat. at 18-19° contain 63·20 pts. of the three salts. (v. Hauer, J. pr. **98.** 137.)

Very sl. sol. in alcohol.

NaBr+$2H_2O$ is sol. in 1·10 pts. H_2O at 15°; in 159 pts. absolute alcohol at 15°; in 1200 pts. absolute ether at 15°. (Eder, Dingl. **221.** 89.)

NaBr+$2H_2O$ is sol. in 2·25 pts. 60 % alcohol, and 7 pts. 90 % alcohol. NaBr is sol. in 3 pts. 60 % alcohol, and 10 pts. 90 % alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 17·35 pts. at 19·5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sodium stannic bromide.

See **Bromostannate, sodium.**

Sodium carbonyl, $Na_2C_2O_2$.

Decomp. by H_2O with explosion. (Joannis, C. R. **116.** 1518.)

Sodium chloride, NaCl.

Sol. in H_2O. If NaCl is dissolved in 15 pts. H_2O, heat is absorbed if the temp. is 15°, but much less if temp. is 86°; at 100° there is neither absorption nor evolution of heat. (Berthelot, C. R. **78.** 1722.)

36 pts. NaCl mixed with 100 pts. H_2O at 12·6° lower the temp. 2·5°. (Rüdorff, B. **2.** 68.)

33 pts. NaCl with 100 pts. snow at −1° give a temp. of −21·3°. (Rüdorff, Pogg. **122.** 337.)

100 pts. H_2O at t° dissolve pts. NaCl.

t°	Pts. NaCl	Authority.
0	More than at 13·89°	Gay-Lussac, A. ch. (2) **11.** 310.
13·89	35·81	
16·90	35·88	
59·93	37·14	
109·73	40·38	
12	35·91	Fehling, A. **77.** 382.
100	39·92	
18·75	37·741	Bischof.
10-15	35·42	Bergmann.
106+	42·86	Griffiths, **1825.**
20	35·9	Schiff, A. **109.** 326.
All temps.	37	Fuchs and Reichenbach, **1826.**
25	35·7	Kopp, A. **34.** 262.
18·75	36·53	C. J. B. Karsten, **1840.**
1	36·121	G. Karsten.
18·75	36·724	
100	41·076	
1·25	36·119	Unger, J. pr. **8.** 285.
Boiling	39·324	
18·75	35·40	Karsten (?), cited by Unger, *l.c.*
100	36·95	
15·56	34·2-35·42	Ure's Dict.
100	36·16	
15	35·837	Michel and Krafft.

1 pt. NaCl is sol. in 2·789 pts. H_2O at 15° (Gerlach); in 3 pts. H_2O at 18·75° (Abl); in 2·8235 pts. H_2O at ord. temp. (Bergmann); in 2·7647 pts. boiling H_2O (Bergmann); in 2·857 pts. hot or cold H_2O (Fourcroy).

Not deposited from boiling aqueous solution unless the vessel containing it is open to the air. (Unger, *l.c.*)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
1·5	33·6	70	38·1
13·75	35·8	108·5	39·4

(Nordenskjöld, Pogg. **136.** 315.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
13·89	35·8	59·93	37·1
16·90	35·9	109·73	40·4

(Gay-Lussac, A. ch. **11.** 296.)

Solubility of NaCl in H_2O at various pressures. The figures represent pts. NaCl in 100 pts. sat. NaCl+Aq at t° and A pressure in atmospheres.

A	0°	9°	12°	15°	20°	25°	30°
1	26·25	26·32	26·35	26·30	26·35	26·37	26·47
20	26·35	26·38	..	26·39	26·37	26·47	26·53
40	26·44	..	..	26·40	..	..	..

(Müller, Pogg. **117.** 386.)

100 pts. H_2O dissolve at t°.

t°	Pts. NaCl	t°	Pts. NaCl
−15	32·73	40	36·64
−10	33·49	50	36·98
− 5	34·22	60	37·25
0	35·52	70	37·88
5	35·63	80	38·22
9	35·74	90	38·87
14	35·87	100	39·61
25	36·13	109·7	40·35

(Poggiale, A. ch. (3) **8.** 649.)

100 pts. H_2O dissolve at :

0°	9°	12°	15°	
35·59	35·72	35·77	35·68	pts. NaCl,

20°	25°	30°	
35·77	35·81	36·00	pts. NaCl.

(Müller, Pogg. **122**. 337.)

100 pts. H_2O dissolve 35·76-36·26 pts. NaCl at 15·6°, and the sp. gr. of sat. solution = 1·204. (Page and Keightley, Chem. Soc. (2) **10**. 566.)

100 pts. NaCl + Aq sat. at 18-19° contain 26·47 pts. NaCl. (v. Hauer, J. pr. **98**. 137.)

Solubility of NaCl in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
0	35·7	37	36·5	74	38·1
1	35·7	38	36·5	75	38·2
2	35·7	39	36·6	76	38·2
3	35·7	40	36·6	77	38·2
4	35·7	41	36·6	78	38·2
5	35·7	42	36·7	79	38·3
6	35·7	43	36·7	80	38·4
7	35·7	44	36·8	81	38·4
8	35·7	45	36·8	82	38·5
9	35·7	46	36·8	83	38·6
10	35·8	47	36·9	84	38·6
11	35·8	48	36·9	85	38·7
12	35·8	49	36·9	86	38·7
13	35·8	50	37·0	87	38·8
14	35·8	51	37·0	88	38·9
15	35·9	52	37·0	89	39·0
16	35·9	53	37·1	90	39·1
17	35·9	54	37·1	91	39·1
18	35·9	55	37·1	92	39·2
19	36·0	56	37·2	93	39·3
20	36·0	57	37·2	94	39·3
21	36·0	58	37·2	95	39·4
22	36·0	59	37·3	96	39·4
23	36·1	60	37·3	97	39·5
24	36·1	61	37·3	98	39·6
25	36·1	62	37·4	99	39·7
26	36·1	63	37·4	100	39·8
27	36·2	64	37·5	101	39·8
28	36·2	65	37·5	102	39·9
29	36·2	66	37·6	103	40·0
30	36·3	67	37·7	104	40·0
31	36·3	68	37·7	105	40·1
32	36·3	69	37·8	106	40·1
33	36·4	70	37·9	107	40·2
34	36·4	71	37·9	108	40·3
35	36·4	72	38·0	109	40·3
36	36·5	73	38·0	109·7	40·4

(Calculated by Mulder from his own and other observations, Scheik. Verhandel. **1864**. 37.)

Solubility in 100 pts. H_2O at :

0-4°	20°	40°	60°	80°
35·630	35·825	36·32	37·06	38·00

(Andreae, J. pr. (2) **29**. 456.)

Solubility in 100 pts. H_2O from most careful experiments.

0°	20°	60°	80°
35·571	35·853	37·091	38·046

(Raupenstrauch, M. Ch. **6**. 563.)

Solubility of NaCl in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
−14·0	32·5	44·75	36·64
−13·8	32·15	52·5	37·04
− 6·25	34·22	55·0	36·99
− 5·95	34·15	59·75	37·31
0	35·7	71·3	37·96
3·6	35·79	74·45	37·96
5·3	35·8	82·05	38·41
14·45	35·94	86·7	38·47
20·85	35·63	93·65	38·90
25·45	35·90	101·7	40·76
38·55	36·52	...	...

Solubility above 20° is represented by the formula $S = 34·359 + 0·0527t$. (Coppet, A. ch. (5) **30**. 426.)

Solubility of NaCl in 100 pts. H_2O at high temp.

t°	Pts. NaCl	t°	Pts. NaCl
118	39·8	160	43·6
140	42·1	180	44·9

(Tilden and Shenstone, Phil. Trans. **1884**. 23.)

Sp. gr. of NaCl + Aq containing 15 % NaCl is 1·109 at 15° (Francœur); 1·116 at 15° (Soubeiran); 1·1107 at 15° (Coulier); 1·111 at 15° (Baudin, C. R. **68**. 932).

Sp. gr. of NaCl + Aq saturated at 15° is 1·20715 (Michel and Krafft); at 17·5° is 1·2046 (Karsten); at 8° is 1·205 (Anthon).

Sp. gr. of NaCl + Aq.

% NaCl	Sp. gr.	% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1·037	15	1·112	25	1·192
10	1·074	20	1·154	26·43	1·204

(Dahlmann, J. B. **7**. 323.)

Sp. gr. of NaCl + Aq at 20°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1·0066	15	1·1090
2	1·0133	16	1·1168
3	1·0201	17	1·1247
4	1·0270	18	1·1327
5	1·0340	19	1·1408
6	1·0411	20	1·1490
7	1·0483	21	1·1572
8	1·0556	22	1·1655
9	1·0630	23	1·1738
10	1·0705	24	1·1822
11	1·0781	25	1·1906
12	1·0857	26	1·1990
13	1·0934	27	1·2075
14	1·1012	...	...

(Schiff, A. **110**. 76.)

Sp. gr. of NaCl + Aq at 19·5°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
6·402	1·0460	22·631	1·1712
12·265	1·0895	26·530	1·2036
17·533	1·1303	...	...

(Kremers, Pogg. **95**. 120.)

Sp. gr. of NaCl+Aq at 15°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1·00725	15	1·11146
2	1·01450	16	1·11938
3	1·02174	17	1·12730
4	1·02899	18	1·13523
5	1·03624	19	1·14315
6	1·04366	20	1·15107
7	1·05108	21	1·15931
8	1·05851	22	1·16755
9	1·06593	23	1·17580
10	1·07335	24	1·18404
11	1·08097	25	1·19228
12	1·08859	26	1·20098
13	1·09622	26·395	1·20433
14	1·10384	...	...

(Gerlach, Z. anal. **8.** 279.)

Sp. gr. of NaCl+Aq at 18°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1·0345	25	1·1898
10	1·0707	26	1·1982
15	1·1087	26·4	1·2014
20	1·1477	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of NaCl+Aq at 20°, containing n mols. H_2O to 1 mol. NaCl.

n	Sp. gr.	n	Sp. gr.
12·5	1·15292	100	1·02069
25	1·08207	200	1·00965
50	1·04227	...	...

(Marignac, J. B. **1870.** 110.)

Sp. gr. of NaCl+Aq at 0°. NaCl=g. NaCl to 100 g. H_2O; d^o = sp. gr. at 0°; d^T = maximum sp. gr.; T=temp. of maximum.

g. NaCl	d^o	d^T	T
0	1·00000	1·000130	+ 4°
0·5	1·003925	1·003988	+ 3
1	1·007634	1·007666	+ 1·77
2	1·015366	1·015367	− 0·58
3	1·023530	1·023583	− 3·24
4	1·030669	1·030890	− 5·63
6	1·045975	1·046952	−11·07

(Rosetti, A. ch. (4) **17.** 382.)

Sp. gr. of NaCl+Aq at 20°. x=mols. NaCl to 100 mols. H_2O.

x	Sp. gr.	x	Sp. gr.
0·5	1·01145	4·0	1·08408
1·0	1·02255	5·0	1·10276
2·0	1·04393	...	...

(Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of NaCl+Aq at 0°. S=weight of salt in 100 g. of solution of the given sp. gr.; S_1=No. mols. of salt contained in 100 mols. of the solution.

S	S_1	Sp. gr.
23·0821	8·627	1·1821
19·1932	6·769	1·1502
14·3415	4·898	1·1111
9·4120	3·097	1·0722
5·1536	1·644	1·0394

(Charpy, A. ch. (6) **29.** 23.)

The saturated solution boils at 109°. (Kremers.)

NaCl+Aq containing 42·9 pts. NaCl to 100 pts. H_2O boils at 106·8° (Griffiths); containing 41·2 pts. NaCl to 100 pts. H_2O boils at 108·2° (Legrand); containing 40·38 pts. NaCl to 100 pts. H_2O boils at 109·73° (Gay-Lussac); containing 38·7 pts. NaCl to 100 pts. H_2O forms a crust at 108·3°; highest point observed, 108·8° (Gerlach, Z. anal. **26.** 426).

Boiling-point of NaCl+Aq.

% NaCl	B.-pt. according to	
	Bischof	G. Karsten
5	101·50°	101·10°
10	103·03	102·38
15	104·63	103·83
20	106·26	105·46
25	107·93	107·27
29·4	107·9-108·99	...

% NaCl	B.-pt. according to	
	Legrand	Gerlach
5	100·80°	100·9°
10	101·75	101·9
15	103·00	103·3
20	104·60	105·3
25	106·60	107·6

B.-pt. of NaCl+Aq containing pts. NaCl to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 438); L=according to Legrand (A. ch. (2) **59.** 431).

B.-pt.	G	L	B.-pt.	G	L
100·5°	3·4	4·4	105·5°	27·5	29·8
101	6·6	7·7	106	29·5	31·8
101·5	9·6	10·8	106·5	31·5	33·9
102	12·4	13·4	107	33·5	35·8
102·5	14·9	15·9	107·5	35·5	37·7
103	17·2	18·3	108	37·5	39·7
103·5	19·4	20·7	108·4	...	41·2
104	21·5	23·1	108·5	39·5	...
104·5	23·5	25·5	108·8	40·7	...
105	25·5	27·7	...	...	...

The freezing-point of NaCl+Aq is lowered 0·60° for every gramme NaCl up to 10 g. When more conc. the freezing-point sinks proportional to NaCl, $2H_2O$, 0·342° for every gramme of that salt. (Rüdorff, Pogg. **113.** 163.)

Insol. in conc. HCl+Aq.

Solubility of NaCl in HCl+Aq at 0°. NaCl=mols. NaCl (in milligrammes) dissolved in 10 ccm. of liquid; HCl=mols. HCl (in milligrammes) dissolved in 10 ccm. of liquid.

NaCl	HCl	Sum of mols.	Sp. gr.
53·5	1	54·5	1·2045
52·2	1·85	54·05	1·2025
48·5	5·1	53·6	1·196
44·0	9·275	53·275	1·185
37·95	15·05	53·00	1·1725
23·5	30·75	54·95	1·141
6·1	56·35	62·45	1·1195

(Engel, Bull. Soc. (2) **45.** 654.)

Moderately dil. H_2SO_4 or HNO_3+Aq precipitate NaCl from NaCl+Aq. (Karsten.)

Solubility in NaOH+Aq. NaCl=mols. NaCl (in milligrammes) in 10 ccm. solution; Na_2O=mols. Na_2O (in milligrammes) in 10 ccm. solution.

NaCl	Na_2O	Na_2O+NaCl	Sp. gr.
54·7	0	54·7	1·207
49·375	4·8	54·175	1·221
47·212	6·725	53·937	1·225
42·375	10·406	52·781	1·236
39·55	14·78	54·33	1·249
24·95	30·5	55·45	1·295
19·3	37·875	57·175	1·314
9·408	53·25	62·66	1·362

(Engel, C. R. **112.** 1130.)

The presence of other salts increases the solubility of NaCl in H_2O.

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl. When the reaction is complete, the solution has sp. gr. 1·1788, and contains 32·62 % mixed salts; or 100 pts. H_2O dissolve 48·42 pts. mixed salts, viz., 26·36 pts. NaCl and 22·06 pts. NH_4Cl. (Karsten.) (See under NH_4Cl.)

Sol. in sat. $BaCl_2$+Aq with pptn. of $BaCl_2$ until a state of equilibrium is reached, when 100 pts. H_2O at 17° dissolve 38·6 pts. of mixed salts, of which 4·1 pts. are $BaCl_2$. (Karsten.) (See under $BaCl_2$.)

100 pts. NaCl+NaI+Aq sat. at 18-19° contain 62·33 pts. of the two salts. (v. Hauer.)

Insol. in sat. $CaCl_2$+Aq. (Vauquelin, Ann. de Chim. **13.** 95.)

Much more sol. in hot than in cold H_2O containing $MgCl_2$ or $CaCl_2$; but NaCl is pptd. from sat. NaCl+Aq when that solution is mixed with $MgCl_2$ or $CaCl_2$+Aq. (Fuchs and G. Reichenbach, **1826.**) (See under $MgCl_2$.)

Less sol. in conc. $CaCl_2$+Aq than in H_2O. (Hermann.)

Sol. in sat. KCl+Aq with elevation of temp. (Vauquelin.) (See under KCl.)

Sol. in sat. NH_4NO_3+Aq, without causing pptn. (Karsten.)

Sol. in sat. NH_4NO_3+Aq, from which solution it is not pptd. by salts which would cause its pptn. in aqueous solution. (Margueritte, C. R. **38.** 307.)

Sol. in sat. $NaNO_3$+Aq with pptn. of $NaNO_3$.

Sol. in sat. KNO_3+Aq, the mixed solution having the power to dissolve more KNO_3, and the solubility of the KNO_3 apparently increasing in the same ratio as the amount of NaCl present. (Fourcroy and Vauquelin, Ann. de Chim. **11.** 130.) (See under KNO_3.)

Sol. in sat. KNO_3+Aq; the solution thus obtained at 18·13° contains 40·34 % of the mixed salts, or 100 pts. H_2O dissolve 67·72 pts. of the mixed salts, viz., 38·25 pts. NaCl and 29·45 pts. KNO_3. (Karsten.)

Sol. in sat. $Ba(NO_3)_2$+Aq without causing pptn.

Insol. in $Ca(NO_3)_2$+Aq.

Sol. in $Mg(NO_3)_2$+Aq with pptn. of small portion of $Mg(NO_3)_2$.

Sol. in sat. $(NH_4)_2SO_4$+Aq with pptn. of considerable amt. of $(NH_4)_2SO_4$+Aq. (Vauquelin.)

Sol. in cold sat. $NaSO_4$+Aq at first without pptn., afterwards Na_2SO_4 separates out. (Karsten.)

100 pts. H_2O dissolve 36·71 pts. NaCl and 7·19 pts. K_2SO_4 at 15°, and solution has sp. gr. 1·24. (Page and Keightley.)

NaCl is sol. in K_2SO_4+Aq, and *vice versa*, without separation of a salt.

100 pts. H_2O dissolve 7·03 pts. K_2SO_4 and 37·60 pts. NaCl, when warmed and cooled to 14°. (Rüdorff.)

Solubility of NaCl and K_2SO_4 in H_2O at t°. 100 pts. H_2O contain pts. NaCl, K_2SO_4, and KCl.

t°	Pts. NaCl	Pts. K_2SO_4	Pts. KCl
10	33·43	8·10	3·18
20	34·01	8·90	3·06
30	34·56	9·56	2·95
40	35·16	10·38	2·81
50	35·77	11·07	2·84
60	36·40	11·93	2·72
70	36·64	12·82	3·20
80	36·04	12·26	5·06
90	35·86	12·42	6·98
100	35·63	12·56	8·79

(Precht and Wittgen, B. **15.** 1666.)

Sol. in sat. $CuSO_4$+Aq.

Sol. in sat. $ZnSO_4$+Aq with separation of Na_2SO_4, $ZnSO_4$. (Karsten.)

Sol. in sat. $Al_2(SO_4)_3$+Aq with no pptn. (Vauquelin.)

Sol. in sat. $KClO_3$+Aq; the solution can then dissolve more $KClO_3$. (Margueritte, C. R. **38.** 305.)

Solubility in alcohol.

100 pts. alcohol of 0·900 sp. gr. dissolve 5·8 pts. NaCl; of 0·872 sp. gr. dissolve 3·67 pts. NaCl; of 0·834 sp. gr. dissolve 0·5 pt. NaCl. (Kirwan.)

100 pts. alcohol containing given % by weight of absolute alcohol dissolve pts. NaCl at 25°.

% alcohol	Pts. NaCl	% alcohol	Pts. NaCl	% alcohol	Pts. NaCl
0·0	35·70	33·4	16·08	66·9	5·95
8·4	30·49	41·8	13·28	75·2	3·75
16·7	24·84	50·2	11·28	83·6	1·59
25·1	19·30	58·5	7·96	..	..

(Kopp, A. **40.** 206.)

100 pts. alcohol of 75 % by weight dissolve at:

14°	15·2°	38°	71·5°	
0·661	0·700	0·736	1·033	pts. NaCl.

100 pts. alcohol of 95·5 % by weight dissolve at:

15°	77·2°	
0·174	0·171	pts. NaCl.

(Wagner, A. **64.** 293.)

100 pts. alcohol containing % alcohol by weight dissolve pts. NaCl at 15°, or 100 pts. solution contain % NaCl.

10	20	30	40	50	60	80	% alcohol,
28·53	22·55	17·51	13·25	9·77	5·93	1·22	pts. NaCl,
22·2	18·4	14·9	11·7	8·9	5·6	1·2	% NaCl.

(Schiff, A. **118.** 365.)

Solubility of NaCl in alcohol increases with the temperature.

100 pts. (by weight) of alcohol of 0·9282 sp. gr. (50·5 % by weight) dissolve at:

4°	10°	13°	23°	32°	33°	44°	51°	60°	
10·9	11·1	11·43	11·9	12·3	12·5	13·1	13·8	14·1	pts. NaCl.

(Gerardin, A. ch. (4) **5.** 146.)

Solubility in alcohol at 13°.

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	Salt
1·2030	0	88·70	31·60
1·1348	11·81	78·41	23·26
1·1144	15·99	74·64	20·81
1·0970	19·39	71·45	18·86
1·0698	24·95	65·80	16·23
1·0295	32·33	57·96	12·66
0·9880	40·33	49·34	9·13
0·9445	49·28	38·54	5·93
0·9075	57·91	29·37	3·47
0·8700	63·86	21·62	1·52
0·8400	72·26	11·24	0·50

(Bodländer, Z. phys. Ch. **7.** 317.)

100 pts. absolute methyl alcohol dissolve 1·41 pts. at 18·5°; 100 pts. absolute ethyl alcohol dissolve 0·065 pt. at 18·5°. (de Bruyn, Z. phys. Ch. **10.** 782.)

100 pts. wood-spirit of 40 % (by weight) dissolve 13·0 pts. NaCl. (Schiff, A. **118.** 365.)

Ether ppts. NaCl from NaCl + Aq. (Gmelin.)

Very sl. sol. in a mixture of equal pts. of absolute alcohol and ether. (Berzelius.)

500 mg. NaCl treated with above mixture yielded only 0·5 mg. to the liquid. (Lawrence Smith, Am. J. Sci. (2) **16.** 57.)

100 pts. of a mixture of 1 pt. 96 % alcohol and 1 pt. 98 % ether dissolve 0·11 pt. NaCl. (Mayer, A. **98.** 205.)

Insol. in oil of turpentine. (T. S. Hunt, Am. J. Sci. (2) **19.** 417.)

Sol. in glycerine. (Pelouze.)

Insol. in fusel oil. (Gooch, Am. Ch. J. **9.** 53.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Min. *Halite.*

$+2H_2O$. Efflorescent below 0°; sl. deliquescent at temps. above 0°. (Fuchs, **1826.**)

$+10H_2O$. (Naumann.)

Sodium *sub*chloride, Na_4Cl_2.

Decomp. by H_2O into NaCl and NaOH + Aq.

Sodium stannic chloride, $2NaCl, SnCl_4+6H_2O$.

See **Chlorostannate, sodium.**

Sodium zinc chloride, $2NaCl, ZnCl_2+3H_2O$.

Deliquescent. Easily sol. in H_2O. (Schindler, Mag. Pharm. **36.** 48.)

Sodium zirconium chloride, $2NaCl, ZrCl_4$.

(Paykull.)

Sodium chloroiodide, $NaCl_4I+2H_2O$.

Easily decomp. by alcohol or ether. (Wells and Wheeler, Sill. Am. J. **143.** 42.)

Sodium fluoride, NaF.

Very sl. sol. in cold, and not more abundantly in boiling H_2O. (Rose.)

100 pts. H_2O dissolve 4·78 pts. at 16°. (Berzelius.)

100 pts. H_2O dissolve 4 pts. at 15°. (Fremy, A. ch. (3) **47.** 32.)

Sl. sol. in conc. $KC_2H_3O_2$ + Aq. (Stromeyer.)

Sp. gr. of aqueous solutions containing in 100 pts. H_2O:

1·1081	2·2162	3·3243 pts. NaF.
1·0110	1·0221	1·0333

Sat. solution has sp. gr. 1·0486. (Gerlach, Z. anal. **27.** 277.)

Almost insol. in alcohol. (Berzelius, Pogg. **1.** 13.)

Sodium hydrogen fluoride, $NaHF_2$.

Rather difficultly sol. in cold, more easily in hot H_2O. (Berzelius, Pogg. **1.** 13.)

Sodium stannous fluoride, $2NaF, 3SnF_2$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Sodium stannic fluoride.

See **Fluostannate, sodium.**

Sodium tantalum fluoride.

See **Fluotantalate, sodium.**

Sodium tellurium fluoride, NaF, TeF_4.

Decomp. by H_2O. (Berzelius.)

Sodium titanium fluoride.

See **Fluotitanate, sodium.**

Sodium tungstyl fluoride.

See **Fluoxytungstate, sodium.**

Sodium uranium fluoride, NaF, UF_4 (?).

Somewhat soluble in H_2O. (Bolton.)

Sodium uranyl fluoride.

See **Fluoxyuranate, sodium.**

Sodium vanadium ***sesqui*****fluoride.**

See **Fluovanadate, sodium.**

Sodium zinc fluoride, NaF, ZnF_2.

Sol. in H_2O. (R. Wagner.)

Sodium zirconium fluoride, 5NaF, $2ZrF_4$.

See **Fluozirconate, sodium.**

Sodium fluoride vanadium ***pent*****oxide.**

See **Fluoxyvanadate, sodium.**

Sodium hydrogenide, Na_2H_4.

Decomp. violently by H_2O.

Sodium hydrosulphide, NaSH.

Deliquescent. Sol. in H_2O and alcohol.

$+3H_2O$. Difficultly sol. in H_2O. (Damoiseau, C. C. **1885**. 36.)

Sodium hydroxide, NaOH.

Very deliquescent. 100 pts. NaOH under a bell jar with H_2O at 16-20° absorb 552 pts. in 56 days. (Mulder.)

Very sol. in H_2O with evolution of much heat. Sol. in 0·47 pt. H_2O. (Bineau, C. R. **41**. 509.)

Sp. gr. and b.-pt. of NaOH+Aq.

% Na_2O	Sp. gr.	B.-pt.	% Na_2O	Sp. gr.	B.-pt.
4·7	1·06	100·56°	31·0	1·44	120·00°
9·0	1·12	101·11	34·0	1·47	123·89
13·0	1·18	102·78	36·8	1·50	129·44
16·0	1·23	104·44	41·2	1·56	137·78
19·0	1·29	106·66	46·6	1·63	148·89
23·0	1·32	108·89	53·8	1·72	204·44
26·0	1·36	112·78	63·6	1·85	315·56
29·0	1·40	116·66	77·8	2·00	red heat.

(Dalton.)

Sp. gr. of NaOH+Aq at 15°.

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
0·302	1·0040	10·879	1·1630	21·154	1·3053
0·601	1·0081	11·484	1·1734	21·758	1·3125
1·209	1·0163	12·088	1·1841	21·894	1·3143
1·813	1·0246	12·692	1·1948	22·363	1·3198
2·418	1·0330	13·297	1·2058	22·967	1·3273
3·022	1·0414	13·901	1·2178	23·572	1·3349
3·626	1·0500	14·506	1·2280	24·176	1·3426
4·231	1·0587	15·110	1·2392	24·780	1·3505
4·835	1·0675	15·714	1·2453	25·385	1·3586
5·440	1·0764	16·319	1·2515	25·989	1·3668
6·044	1·0855	16·923	1·2578	26·594	1·3751
6·648	1·0948	17·528	1·2642	27·200	1·3836
7·253	1·1042	18·132	1·2708	27·802	1·3923
7·857	1·1137	18·730	1·2775	28·407	1·4011
8·462	1·1233	19·341	1·2843	29·011	1·4101
9·066	1·1330	19·954	1·2912	29·616	1·4193
9·670	1·1428	20·550	1·2982	30·220	1·4285
10·275	1·1528	..	..	..	..

(Tünnermann, N. J. Pharm. **18**. 2.)

Sp. gr. of NaOH+Aq.

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
2·07	1·02	14·73	1·16	28·16	1·30
4·02	1·04	16·73	1·18	29·96	1·32
5·89	1·06	18·71	1·20	31·67	1·34
7·69	1·08	20·66	1·22	32·40	1·35
9·43	1·10	22·58	1·24	33·08	1·36
11·10	1·12	24·47	1·26	34·41	1·38
12·81	1·14	26·33	1·28	..	..

(Richter.)

Sp. gr. of NaOH+Aq at 15°.

%	Sp. gr. if % is Na_2O	Sp. gr. if % is NaOH	%	Sp. gr. if % is Na_2O	Sp. gr. if % is NaOH
1	1·015	1·012	32	1·450	1·351
2	1·020	1·023	33	1·462	1·363
3	1·043	1·035	34	1·475	1·374
4	1·058	1·046	35	1·488	1·384
5	1·074	1·059	36	1·500	1·395
6	1·089	1·070	37	1·515	1·405
7	1·104	1·081	38	1·530	1·415
8	1·119	1·092	39	1·543	1·426
9	1·132	1·103	40	1·558	1·437
10	1·145	1·115	41	1·570	1·447
11	1·160	1·126	42	1·583	1·456
12	1·175	1·137	43	1·597	1·468
13	1·190	1·148	44	1·610	1·478
14	1·203	1·159	45	1·623	1·488
15	1·219	1·170	46	1·637	1·499
16	1·233	1·181	47	1·650	1·508
17	1·245	1·192	48	1·663	1·519
18	1·258	1·202	49	1·678	1·529
19	1·270	1·213	50	1·690	1·540
20	1·285	1·225	51	1·705	1·550
21	1·300	1·236	52	1·719	1·560
22	1·315	1·247	53	1·730	1·570
23	1·329	1·258	54	1·745	1·580
24	1·341	1·269	55	1·760	1·591
25	1·355	1·279	56	1·770	1·601
26	1·369	1·290	57	1·785	1·611
27	1·381	1·300	58	1·800	1·622
28	1·395	1·310	59	1·815	1·633
29	1·410	1·321	60	1·830	1·643
30	1·422	1·332	70	...	1·748
31	1·438	1·343	...	...	...

(Gerlach, Z. anal. **8**. 279, calculated from Schiff, A. **107**. 300.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
0·61	1·0070	4·96	1·0549
0·9	1·0105	5·29	1·0588
1·0	1·0107	5·58	1·0627
1·2	1·0141	5·87	1·0667
1·6	1·0177	6·21	1·0706
2·0	1·0213	6·55	1·0746
2·36	1·0249	6·76	1·0787
2·71	1·0286	7·31	1·0827
3·0	1·0318	7·66	1·0868
3·35	1·0360	8·0	1·0909
3·67	1·0397	8·34	1·0951
4·0	1·0435	8·68	1·0992
4·32	1·0473	9·0	1·1030
4·64	1·0511	9·42	1·1077

Sp. gr. of $NaOH+Aq$ at 15°—*Continued.*

% NaOH	Sp. gr.	% NaOH	Sp. gr.
9·74	1·1120	26·31	1·2905
10·0	1·1158	26·83	1·2973
10·5	1·1195	27·31	1·3032
10·97	1·1250	27·8	1·3091
11·42	1·1294	28·31	1·3151
11·84	1·1339	28·83	1·3211
12·24	1·1383	29·38	1·3272
12·64	1·1423	30·0	1·3339
13·0	1·1474	30·57	1·3395
13·55	1·1520	31·22	1·3458
13·86	1·1566	31·85	1·3521
14·5	1·1631	32·47	1·3585
14·75	1·1662	33·0	1·3642
15·0	1·1697	33·69	1·3714
15·5	1·1755	34·38	1·3780
15·91	1·1803	35·0	1·3858
16·38	1·1852	35·65	1·3913
16·77	1·1901	36·25	1·3981
17·22	1·1950	36·86	1·4049
17·67	1·2000	37·47	1·4118
17·12	1·2050	38·13	1·4187
18·58	1·2101	38·8	1·4267
19·0	1·2148	39·39	1·4328
19·58	1·2202	40·0	1·4410
20·0	1·2250	40·75	1·4472
20·59	1·2308	41·41	1·4545
21·0	1·2361	42·12	1·4619
21·42	1·2414	42·83	1·4694
22·0	1·2462	43·66	1·4769
22·64	1·2522	44·38	1·4845
23·15	1·2576	45·27	1·4922
23·67	1·2632	46·15	1·5000
24·24	1·2687	46·87	1·5079
24·81	1·2748	47·60	1·5158
25·3	1·2800	48·81	1·5238
25·8	1·2857	49·02	1·5319

(Hager, Comm. **1883.**)

The sp. gr. increases or diminishes for each degree as follows:

% NaOH	Corr.
40-50	0·00045
30-39	0·0004
20-29	0·0003
10-19	0·0002

(Hager, Comm. **1883.**)

Sp. gr. of $NaOH+Aq$ at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
2·5	1·0280	20	1·2262
5	1·0568	25	1·2823
10	1·1131	30	1·3374
15	1·1790	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $NaOH+Aq$ at 20° containing 2 mols. NaOH to 100 mols. $H_2O=1·04712$. (Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of $NaOH+Aq$ at 15°.

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
5	1·069	25	1·353
10	1·139	30	1·426
15	1·210	35	1·500
20	1·281	...	...

(Hager, Adjumenta Varia, Leipsic, **1876.**)

Sat. $NaOH+Aq$ boils at 215·5° (Griffiths.)

Sat. $NaOH+Aq$ boils at 310°. (Gerlach, Z. anal. **26.** 427.)

$NaOH+Aq$ of 1·500 sp. gr. contains 36·8 % NaOH and boils at 130°.

B.-pt. of $NaOH+Aq$ containing pts. NaOH to 100 pts. H_2O.

B.-pt.	Pts. NaOH	B.-pt.	Pts. NaOH
105°	17	210°	425·5
110	30	215	475·5
115	41	220	526·3
120	51	225	583·3
125	60·1	230	645·2
130	70·1	235	714·3
135	81·1	240	800
140	93·5	245	888·8
145	106·5	250	1000
150	120·4	255	1142·8
155	134·5	260	1333·3
160	150·8	265	1534
165	168·8	270	1739·1
170	187	275	2000
175	208·3	280	2353
180	230	285	2857
185	254·5	290	3571·4
190	281·7	300	4651·1
195	312·3	305	6451·6
200	345	310	10526·3
205	380·9	314	22222·2

(Gerlach, Z. anal. **26.** 463.)

Easily sol. in alcohol or wood spirit; sol. in fusel-oil. Sol. in an aqueous solution of mannite. (Favre, A. ch. (3) **11.** 76.)

Easily sol. in glycerine.

Sol. to a certain extent in ether.

$+1\frac{1}{3}H_2O$. (Cripps, Pharm. J. Trans. (3) **14.** 833.)

$+3\frac{1}{2}H_2O$. Deliquescent. Sol. in H_2O with absorption of much heat. Melts at 6°. (Hermes.)

Sodium iodide, NaI, and, $+2H_2O$.

Solubility of NaI and of $NaI+2H_2O$ in H_2O differ. Below 65° $NaI+2H_2O$ usually separates out, and above that temp. NaI separates.

Solubility of NaI in 100 pts. H_2O at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
71·3	294·4	92·4	300·2	124·7	317·5
74·1	295·3	97·1	300·3	132·5	317·3
81·6	296·8	101·7	302·5	138·1	319·2
86·4	298·3	110·7	306·2	...	...

Solubility is represented by a straight line of the formula S=264·19+0·3978t.

Solubility of $NaI+2H_2O$ in 100 pts. at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
−17	149·4	15	173·7	45	215·6
−15	150·3	20	178·7	50	227·8
− 5	155·4	25	184·2	55	241·2
0	158·7	30	190·3	60	256·8
5	163·6	35	197·0	65	278·4
10	168·6	40	205·1	...	...

(Coppet, A. ch. (5) **30**. 424.)

If solubility S=pts. NaI in 100 pts. solution, S=61·3+0·1712t from 0° to 80°; S=75+0·0258t from 80° to 160°. (Étard, C. R. **98**. 1432.)

$NaI+2H_2O$ is sol. in 0·55 pt. H_2O at 15°. (Eder, Dingl. **221**. 89.)

100 pts. NaI+Aq sat. at 18-19° contain 62·98 pts. NaI. (v. Hauer, J. pr. **98**. 137.)

100 pts. H_2O dissolve at:

0°	20°	40°	60°	
158·7	178·6	208·4	256·4	pts. NaI,
80°	100°	120°	140°	
303	312·5	322·5	333·3	pts. NaI.

(Kremers, Pogg. **97**. 14.)

Sat. solution boils at 141°.

Sp. gr. of NaI+Aq at 19·5° containing:

5	10	15	20	25	30 % NaI,
1·040	1·082	1·128	1·179	1·234	1·294
35	40	45	50	55	60 % NaI.
1·360	1·432	1·510	1·60	1·70	1·81

(Gerlach, Z. anal. **8**. 285.)

$+2H_2O$. Sol. in 12·0 pts. absolute alcohol; in 360 pts. ether. (Eder, Dingl. **221**. 89.)

Sol. in 3 pts. 90 % alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 77·7 pts. NaI at 22·5°; ethyl alcohol, 43·1 pts. (de Bruyn, Z. phys. Ch. **10**. 783.)

Sol. in ethyl acetate. (Casaseca, C. R. **30**. 821.)

Sodium stannous iodide, NaI, SnI_2.

Very sol. in H_2O. When treated with little H_2O, NaI is dissolved out, but a larger amt. of H_2O dissolves it completely. (Boullay, A. ch. (2) **34**. 375.)

Sodium zinc iodide, 2NaI, ZnI_2+3H_2O.

Deliquescent.

Sodium oxide, Na_2O.

Very deliquescent, and sol. in H_2O with evolution of heat.

See **Sodium hydroxide.**

Sodium ***per*****oxide**, Na_2O_2.

Deliquescent, and very sol. in H_2O with partial decomp.

Solution decomp. on boiling.

Cryst. with $2H_2O$, and $8H_2O$. (Fairley, Chem. Soc. **1877**. 125.)

Forms hydrate $Na_2O_2(OH)_4+4H_2O$.

Easily sol. in H_2O or dil. acids without decomp. (Schöne, A. **193**. 241.)

Sodium selenide, Na_2Se.

Very deliquescent. Decomp. by H_2O. (Uelsmann, A. **116**. 127.)

Cryst. with $16H_2O$, $9H_2O$, and $\frac{9}{2}H_2O$. (Fabre, C. R. **102**. 613.)

Sodium ***di*****selenide**, Na_2Se_2.

(Jackson, B. **7**. 1277.)

Sodium ***mono*****sulphide**, Na_2S.

Sol. in H_2O. Much less sol. in alcohol than in H_2O. Insol. in ether. (Roussin.)

$+6H_2O$. Less efflorescent than with $9H_2O$. Sol. in H_2O and alcohol.

$+9H_2O$. Efflorescent. Much less sol. in alcohol than H_2O. When dissolved in H_2O, temp. sinks from +22 to −6·1°. (Finger, Pogg. **128**. 635.)

$+5H_2O$. (Göttig, J. pr. (2) **34**. 229.)

Sodium ***di*****sulphide**, Na_2S_2.

Sol. in H_2O and alcohol.

$+5H_2O$. Not efflorescent.

Sodium ***tri*****sulphide**, Na_2S_3.

Sol. in H_2O with decomp.

Cryst. with $3H_2O$ from an alcoholic solution. (Böttger, A. **223**. 355.)

Sodium ***tetra*****sulphide**, $Na_2S_4+6H_2O$.

Very deliquescent, and sol. in H_2O. Difficultly sol. in absolute alcohol. Insol. in ether. (Schöne.)

$+8H_2O$. Efflorescent. (Böttger.)

Sodium ***penta*****sulphide**, $Na_2S_5+6H_2O$.

Sol. in H_2O. (Schöne.)

Sol. in alcohol.

$+8H_2O$. (Böttger.)

Solution is easily decomp. by warming. (Jones, Chem. Soc. **37**. 461.)

Sodium tellurium sulphide.

See **Sulphotellurate, sodium.**

Sodium stannic sulphide.

See **Sulphostannate, sodium.**

Sodium yttrium sulphide, Na_2S, Y_2S_3.

Decomp. by dil. acids, even by $HC_2H_3O_2+$Aq. (Duboin, C. R. **107**. 243.)

Sodium zinc sulphide, Na_2S, 3ZnS.

Not so stable as the corresponding K salt. (Schneider, J. pr. (2) **8**. 29.)

Sodium telluride, Na_2Te.

Sol. in H_2O. (Demarçay, Bull. Soc. (2) **40**. 99.)

Stannic acid, H_2SnO_3.

Insol. in H_2O. Sol. in HCl, and H_2SO_4+Aq, even when dil. (Fremy.) Easily sol. in acids, from which solution it may be pptd. by dilution or boiling. While moist it is sol. in HNO_3+Aq, but gradually separates on standing, and coagulates at once when heated to 50°. If NH_4NO_3 be added to the solution, it remains clear at ord. temp. (Berzelius.)

Easily sol. in HNO_3+Aq, when previously treated with NH_4OH+Aq. (Thénard.)

Easily sol. in KOH+Aq, but addition of large excess ppts. K_2SnO_3, insol. in KOH+Aq.

Easily sol. in NaOH+Aq, and not pptd. by an excess of that reagent. (Barfoed, J. B. **1867**. 267.)

Sl. sol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq.

Completely sol. in K_2CO_3+Aq, but not in Na_2CO_3+Aq.

Insol. in alkali hydrogen carbonates or NH_4Cl+Aq.

Sol. in alkali sulphides+Aq. (Berzelius.)

Sol. in triethyltoluenyl ammonium hydrate+Aq.

Not pptd. by NH_4OH+Aq in presence of Na citrate+Aq.

SnO_2, $2H_2O$. (Weber, Pogg. **122**. 358.)

"*a-Orthostannic acid.*" Easily sol. in HCl+Aq. (Neumann, M. **12**. 515.)

$H_{10}Sn_5O_{15}$ (?).

Metastannic acid. Insol. in H_2O, HNO_3, or H_2SO_4+Aq. Insol. in HCl+Aq, but converted thereby into metastannic chloride, which dissolves after excess of HCl has been removed. (Fresenius.) Insol. in HCl+Aq of sp. gr. 1·1. (Barfoed.) Sol. in large amount of conc. HCl+Aq. (Allen, Chem. Soc. (2) **10**. 274.)

In contact with HCl+Aq metastannic acid is converted into stannic acid. (Barfoed.)

Insol. in HNO_3+Aq even after treatment with NH_4OH+Aq.

Insol. in NH_4OH+Aq.

Sol. in KOH or NaOH+Aq with formation of metastannates, which are insol. in dil. NaOH+Aq, but sol. in H_2O or KOH+Aq, therefore KOH+Aq dissolves metastannic acid, while NaOH+Aq does not, but if the clear solution in KOH+Aq is treated with a large excess of that reagent, a further pptn. occurs. (Barfoed, J. pr. **101**. 368.)

Insol. in K_2CO_3+Aq (Rose); alkali carbonates+Aq. (Fremy.)

Insol. in NH_4Cl+Aq even after long boiling.

Sol. in $Fe(NO_3)_3$+Aq containing HNO_3. (Lepèz and Storch, W. A. B. **98, 2b**. 270.)

Also in $Cr(NO_3)_3$+Aq, but not in $Ce(NO_3)_3$, $Al(NO_3)_3$, $Co(NO_3)_2$+Aq, etc. (L. and S.)

A colloidal metastannic acid sol. in H_2O can be obtained. (Lepèz and Storch.)

According to Weber (Pogg. **122**. 358), stannic and metastannic acids are only different hydrates of same oxide, and it is not a case of allotropic modification.

Colloidal. H_2SnO_3 in colloidal state can be obtained in aqueous solution containing 5·164 g. SnO_2 in a litre. This solution is coagulated by HNO_3+Aq only when in great excess; easily by dil. H_2SO_4+Aq, but not by conc. HCl+Aq. NH_4OH+Aq in large excess causes coagulation; also NH_4Cl, NaOH, NaCl, Na_2SO_4, etc. (Schneider, Z. anorg. **5**. 83.)

Stannates.

Stannates of alkali metals are sol. in H_2O; others are insol. All metastannates, excepting Na, K, and NH_4 salts, are insol. in H_2O. (Fremy, A. ch. (3) **12**. 474.)

Ammonium stannate, $(NH_4)_2O$, $2SnO_2$.

Sol. in H_2O. Insol. in dil. NH_4OH+Aq. (Berzelius.)

+xH_2O. (Moberg, **1838**.)

Ammonium cupric stannate, $(NH_4)_2O$, $CuSnO_3+2H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96**. 701.)

Barium stannate, $BaSnO_3+6H_2O$.

Ppt. Sol. in HCl+Aq. (Moberg.)

$Ba_2SnO_4+10H_2O$. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **95**. 641.)

Calcium stannate, $CaSnO_3+4H_2O$.

Ppt. (Moberg.)

+$5H_2O$. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96**. 701.)

Cobaltous stannate, $CoSnO_3+6H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte.)

Cupric stannate, $CuSnO_3+3H_2O$.

(Moberg.)

+$4H_2O$. Insol. in H_2O. (Ditte.)

Cuprous stannous stannate, Cu_2O, $3SnO$, SnO_2+5H_2O.

Slowly decomp. by dil. acids, and NH_4OH+Aq; completely decomp. by conc. acids. (Lenssen, J. pr. **79**. 90.)

Aurous stannate.

See **Gold purple.**

Lithium stannate *hexa*tungstate, $2Li_2O$, SnO_2, $6WO_3=Li_2SnO_3$, $Li_2W_6O_{19}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27**. 49.)

Magnesium stannate.

Ppt. (Moberg.)

Manganous stannate.

Ppt. (Moberg.)

Mercurous stannate, $Hg_2SnO_3+5H_2O$.

Ppt.

Mercuric stannate, $HgSnO_3+6H_2O$.

Ppt. (Moberg, J. pr. **28**. 231.)

Nickel stannate, $NiSnO_3+5H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96**. 701.)

Platinous sodium stannous stannate, $2PtO$, Na_2O, SnO, SnO_2 (?).

(Schneider, Pogg. **136**. 105.)

Platinous stannous stannate, PtO, $2SnO$, SnO_2.

Decomp. by conc. alkalies. (Schneider, Pogg. **136**. 105.)

Potassium stannate, $K_2SnO_3+3H_2O$.

100 pts. H_2O dissolve 106·6 pts. at 10°, solution has sp. gr.=1·618; 100 pts. dissolve 110·5 pts. at 20°, solution has sp. gr.=1·627. (Ordway, Sill. Am. J. (2) **40**. 173.)

Very sl. sol. in conc. KOH+Aq.

Insol. in $KCl+Aq$. (Fremy.)
Insol. in alcohol.
Pptd. from aqueous solution by the addition of any soluble salt, especially those of K, Na, and NH_4 (Fremy); by NH_4Cl, but not by KCl or NaCl (Ordway).

Potassium *meta*stannate, $K_2O, 10SnO_2$.

$K_2O, 7SnO_2+3H_2O$. Sol. in H_2O. Solution gelatinises on heating. (Rose.)
$K_2O, 6SnO_2+5H_2O$. Sol. in H_2O, but loses its solubility by drying. (Fremy, A. ch. (3) **12**. 475.)
$K_2O, 5SnO_2+4H_2O$. Completely sol. in H_2O. Insol. in alcohol. (Fremy, A. ch. (3) **23**. 396.)
$K_2O, 3SnO_2+3H_2O$. Deliquescent. (Fremy.)

Silver stannate, Ag_2SnO_3.

Insol. in H_2O. Unacted upon by NH_4OH or $HCl+Aq$. (Ditte.)

Argentous stannous stannate (?), Ag_4O, SnO, $3SnO_2+3H_2O$ (?).

Cold dil. HNO_3+Aq slowly dissolves all Ag, hot HNO_3+Aq rapidly.
Easily sol. in boiling conc. H_2SO_4. (Schulze, J. B. **1857**. 257.)

Sodium stannate, $Na_2SnO_3+3H_2O$.

More easily sol. in cold than in hot H_2O. (Fremy.)
Sol. in 2 pts. H_2O at 20° and 100°. (Marignac.)
100 pts. H_2O dissolve 67·4 pts. at 0°, 61·3 pts. at 20°, and solutions have sp. gr. =1·472 and 1·438 at 15·5°. (Ordway, Sill. Am. J. (2) **40**. 173.)
Pptd. from Na_2SnO_3+Aq by salts of K, Na, and NH_4.
$+8H_2O$. (Haeffely, J. B. **1857**. 650.)
$+9H_2O$. (Jones, C. C. **1865**. 607.)
$+10H_2O$. Very efflorescent. (Scheurer-Kestner, Bull. Soc. (2) **8**. 389.)

Sodium *meta*stannate, $Na_2O, 9SnO_2+8H_2O$.

Sol. in H_2O. Insol. in $NaOH+Aq$ or alcohol. (Barfoed, J. B. **1867**. 267.)
$Na_2O, 5SnO_2$. Very difficultly sol. in H_2O. (Fremy, A. ch. (3) **23**. 399.)
Insol. in $KOH+Aq$.
$+8H_2O$. (Haeffely, Chem. Gaz. **1855**. 59.)

Strontium stannate, $3SrO, 2SnO_2+10H_2O$.

Ppt. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **95**. 641.)

Stannous stannate, SnO, $6SnO_2+5H_2O$.

Insol. in H_2O. Decomp. by HNO_3+Aq into metastannic acid. (Schiff, A. **120**. 53.)
Sol. in $HCl+Aq$, and in $KOH+Aq$.

Stannous *meta*stannate, SnO, $7SnO_2$.

SnO, $6SnO_2+9H_2O$. Sol. in $KOH+Aq$ or in $HCl+Aq$. (Fremy.)
$+4H_2O$. (Schiff.)

Zinc stannate, $ZnSnO_3+2H_2O$.

Ppt. (Moberg, **1838**.)

$3ZnO, 2SnO_2+10H_2O$. Insol. in H_2O. Sol. in acids. (Ditte.)

*Per*stannic acid, $H_2Sn_2O_7$.

See **Perstannic acid.**

Stannophosphomolybdic acid.

Ammonium stannophosphomolybdate, $3(NH_4)_2O, 4SnO_2, 3P_2O_5, 16MoO_3+28H_2O$.

Quite insol. even in boiling H_2O. (Gibbs, Am. Ch. J. **7**. 392.)

Stannophosphotungstic acid.

Ammonium stannophosphotungstate, $2(NH_4)_2O, 2SnO_2, P_2O_5, 22WO_3+15H_2O$.

Precipitate. Sl. sol. in boiling H_2O. (Gibbs, Am. Ch. J. **7**. 319.)

Stannosulphuric acid.

See **Sulphate, stannic.**

Stibine.

See **Hydrogen antimonide.**

Strontium, Sr.

Decomp. by H_2O with violence. Dil. H_2SO_4, and $HCl+Aq$ decomp. and dissolve; cold H_2SO_4 attacks slowly. Fuming HNO_3 has scarcely any action even when boiling. (Franz, J. pr. **107**. 253.)

Strontium bromide, $SrBr_2$, and $+6H_2O$.

100 pts. H_2O dissolve at :

0°	20°	38°	59°	83°	110°
87·7	99	112	133	182	250 pts. $SrBr_2$.

(Kremers, Pogg. **103**. 65.)

Sp. gr. of $SrBr_2+Aq$ at 19·5° containing :

5	10	15	20	25 % $SrBr_2$,
1·046	1·094	1·146	1·204	1·266
30	35	40	45	50 % $SrBr_2$.
1·332	1·41	1·492	1·59	1·694

(Kremers, Pogg. **99**. 444 ; calculated by Gerlach, Z. anal. **8**. 285.)

Somewhat sol. in absolute alcohol. (Löwig.)
Much more sol. than $BaBr_2$ in boiling amyl alcohol.

Strontium stannic bromide.

See **Bromostannate, strontium.**

Strontium bromide ammonia, $2SrBr_2, NH_3$.

Sol. in H_2O. (Rammelsberg, Pogg. **55**. 238.)

Strontium chloride, $SrCl_2$, and $+6H_2O$.

Deliquescent in moist air.

Sol. in 1·5 pts. H_2O at 15°, and 0·8 pt. at boiling (Dumas); in 1·996 pts. H_2O at 15° (Gerlach).
1 pt. anhydrous $SrCl_2$ is sol. in 2·27 pts. H_2O at 0°; in 1·88 pts. at 20°; in 1·54 pts. at 40°; in 1·18 pts. at 60°; in 1·08 pts. at 80°; in 0·98 pt. at 100°. (Kremers, Pogg. **103**. 66.)

100 pts. H_2O dissolve 106·2 pts. $SrCl_2+6H_2O$ at 0°, and 205·8 pts. at 40°. (Tilden, Chem. Soc. **45**. 409.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $SrCl_2$	t°	Pts. $SrCl_2$	t°	Pts. $SrCl_2$
0	44·2	41	67·4	81	92·7
1	44·5	42	68·2	82	93·1
2	44·8	43	68·9	83	93·4
3	45·2	44	69·7	84	93·7
4	45·6	45	70·4	85	94·1
5	46·0	46	71·2	86	94·5
6	46·5	47	72·0	87	94·9
7	46·9	48	72·8	88	95·4
8	47·4	49	73·6	89	95·8
9	47·8	50	74·4	90	96·2
10	48·3	51	75·3	91	96·7
11	48·8	52	76·1	92	97·2
12	49·4	53	77·0	93	97·7
13	49·9	54	77·9	94	98·2
14	50·4	55	78·7	95	98·8
15	51·0	56	79·6	96	99·4
16	51·5	57	80·4	97	100·0
17	52·1	58	81·3	98	100·6
18	52·7	59	82·2	99	101·3
19	53·3	60	83·1	100	101·9
20	53·9	61	84·0	101	102·6
21	54·5	62	84·9	102	103·3
22	55·1	63	85·8	103	104·0
23	55·7	64	86·6	104	104·7
24	56·3	65	87·5	105	105·4
25	56·9	66	88·4	106	106·1
26	57·5	66·5	88·8	107	106·9
27	58·1	67	88·9	108	107·6
28	58·7	68	89·1	109	108·4
29	59·3	69	89·3	110	109·1
30	60·0	70	89·6	111	109·9
31	60·6	71	89·8	112	110·7
32	61·3	72	90·1	113	111·4
33	61·9	73	90·3	114	112·2
34	62·5	74	90·6	115	113·0
35	63·2	75	90·9	116	113·8
36	63·9	76	91·2	117	114·6
37	64·6	77	91·5	118	115·5
38	65·3	78	91·8	118·8	116·4
39	66·0	79	92·1	...	...
40	66·7	80	92·4	...	...

(Mulder, Scheik. Verhandel. **1864**. 118.)

100 pts. H_2O dissolve 52·4 pts. $SrCl_2$ at 18°. (Gerardin.)

$SrCl_2+Aq$ sat. at 8° has sp. gr.=1·379. (Anthon, A. **24**. 211.)

Sp. gr. of $SrCl_2+Aq$.

Pts. $SrCl_2$ to 100 pts. H_2O	Sp. gr.	Pts. $SrCl_2$ to 100 pts. H_2O	Sp. gr.
9·81	1·0823	41·04	1·3114
20·12	1·1632	51·69	1·3816
30·57	1·2401	..	..

(Kremers, Pogg. **99**. 444.)

Sp. gr. of $SrCl_2+Aq$ at 15°.

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1·0453	25	1·2580
10	1·0929	30	1·3220
15	1·1439	33	1·3633
20	1·1989	...	...

(Gerlach, Z. anal. **8**. 283.)

Sp. gr. of $SrCl_2+Aq$ at 24·7°. a=No. of $\frac{\text{molecules}}{2}$ in grms. dissolved in 1000 g. H_2O; b=sp. gr. when a=$SrCl_2+6H_2O$, $\frac{1}{2}$ mol. $SrCl_2+6H_2O$=133·5 g.; c=sp. gr. when a=$SrCl_2$, $\frac{1}{2}$ mol.=79·5 g.

a	b	c	a	b	c
1	1·063	1·067	7	1·304	1·401
2	1·118	1·130	8	1·330	...
3	1·166	1·190	9	1·354	...
4	1·207	1·247	10	1·376	...
5	1·243	1·301	11	1·396	...
6	1·275	1·352	...	...	...

(Favre and Valson, C. R. **79**. 968.)

Sp. gr. of $SrCl_2+Aq$ at 18°.

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1·0443	20	1·2023
10	1·0932	22	1·2259
15	1·1456	...	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $SrCl_2+Aq$ at 0°. S=pts. $SrCl_2$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
31·8193	1·3609	18·2629	1·1915
27·7170	1·3086	12·9997	1·1284
23·2300	1·2515	6·7243	1·0637

(Charpy, A. ch. (6) **29**. 24.)

Sat. $SrCl_2+Aq$ boils at 114° (Kremers); 118·8° (Mulder); 117·45°, and contains 117·5 pts. $SrCl_2$ to 100 pts. H_2O (Legrand); forms a crust at 115·5°, and contains 102·7 pts. $SrCl_2$ to 100 pts. H_2O; highest temp. observed, 119°. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of $SrCl_2+Aq$ containing pts. $SrCl_2$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26**. 442); L=according to Legrand (A. ch. (2) **59**. 436.)

B.-pt.	G	L	B.-pt.	G	L
101°	11	16·7	110°	71·4	68·9
102	20·5	25·2	111	76·5	74·1
103	28·9	32·1	112	81·6	79·6
104	36·2	37·9	113	87	85·3
105	43·2	43·4	114	93·1	91·2
106	49·6	48·8	115	99·5	97·5
107	55·4	54·0	116	105·9	104·0
108	60·8	59·0	117	112·3	110·9
109	66·2	63·9	117·5	...	117·5

Melts in its crystal H_2O at 112°. (Tilden, Chem. Soc. **45**. 409.)

Conc. $HCl+Aq$ ppts. part of the $SrCl_2$ from $SrCl_2+Aq$. (Hope.)

Solubility of $SrCl_2$ in HCl + Aq at 0°. $SrCl_2$ = $\frac{1}{2}$ mols. $SrCl_2$ (in milligrammes) dissolved in 10 ccm. of liquid; HCl = mols. HCl (in milligrammes) dissolved in 10 ccm. of liquid.

$SrCl_2$	HCl	Sum of mols.	Sp. gr.
55	0	55·0	1·334
48·2	6·1	54·3	1·3045
41·25	12·75	54·00	1·2695
30·6	23·3	53·9	1·220

(Engel, Bull. Soc. (2) **45**. 655.)

Anhydrous $SrCl_2$ is sol. in 111·6-116·4 pts. alcohol of 99·3 % at 14·5°, and in 26·2 pts. of the same alcohol at boiling. (Fresenius, A. **59**. 127.)

Sol. in 6 pts. alcohol of 0·833 sp. gr. at 15°. (Vauquelin.)

Sol. in 24 pts. absolute alcohol at 15°, and in 19 pts. at boiling. (Bucholz.) Sol. in 2·5 pts. of boiling alcohol.

100 pts. alcohol of given sp. gr. at 0° dissolve pts. $SrCl_2$ at 18°.

0·990 0·985 0·973 0·966 0·953 sp. gr.
49·81 47·0 39·6 35·9 30·4 pts. $SrCl_2$,
0·939 0·909 0·846 0·832 sp. gr.
26·8 19·2 4·9 3·2 pts. $SrCl_2$.

Insol. in absolute alcohol. (Gerardin, A. ch. (4) **5**. 156.)

100 pts. absolute methyl alcohol dissolve 63·3 pts. $SrCl_2+6H_2O$ at 6°; ethyl alcohol, 3·8 pts. (de Bruyn, Z. phys. Ch. **10**. 787.)

Sl. sol. in boiling amyl alcohol. (Browning, Sill. Am. J. **144**. 459.)

Absolutely insol. in acetic ether. (Cann, C. R. **102**. 363.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

$+2H_2O$.

$+6H_2O$. See above.

Strontium stannous chloride, $SrCl_2$, $SnCl_2+4H_2O$.

Sol. in H_2O. (Poggiale, C. R. **20**. 1183.)

Strontium stannic chloride.

See **Chlorostannate, strontium.**

Strontium chloride ammonia, $SrCl_2$, $8NH_3$.

Decomp. by H_2O. (Rose, Pogg. **20**. 155.)

Strontium fluoride, SrF_2.

Somewhat sol. in H_2O. (Fr. Röder.)

Insol. in HF + Aq. (Berzelius.)

Insol. in cold, scarcely sol. in hot H_2O. Boiling HCl + Aq dissolves; sl. attacked by boiling HNO_3 + Aq; decomp. by hot H_2SO_4. (Poulenc, C. R. **116**. 987.)

Strontium stannic fluoride.

See **Fluostannate, strontium.**

Strontium titanium fluoride.

See **Fluotitanate, strontium.**

Strontium hydride, SrH.

Decomp. by H_2O or HCl + Aq. (Winkler, B. **24**. 1976.)

Strontium hydroselenide.

Sol. in H_2O.

Strontium hydrosulphide, SrS_2H_2.

Sol. in H_2O; decomp. by boiling.

Strontium hydroxide, $SrO_2H_2+8H_2O$.

Deliquescent.

Sol. in 50 pts. cold, and 2·4 pts. boiling H_2O (Bucholz); in 50 pts. H_2O at 15·56° (Dalton); in 51·4 pts. H_2O at 15·56°, and 2 pts. at 100° (Hope); in 52 pts. H_2O at 15°, and 2·4 pts. at 100° (Berzelius); in 48 pts. H_2O at 18·75° (Abl).

100 pts. H_2O at 20° dissolve 1·49 pts. SrO. (Bineau, C. R. **41**. 509.)

100 pts. aqueous solution of SrO_2H_2 contain pts. SrO and pts. $SrO_2H_2+8H_2O$ at t°.

t°	Pts. SrO.	Pts. SrO_2H_2 $+8H_2O$.	t°	Pts. SrO.	Pts. SrO_2H_2 $+8H_2O$.
0	0·35	0·90	55	2·54	6·52
5	0·41	1·05	60	3·03	7·77
10	0·48	1·23	65	3·62	9·29
15	0·57	1·46	70	4·35	11·16
20	0·68	1·74	75	5·30	13·60
25	0·82	2·10	80	6·56	16·83
30	1·00	2·57	85	9·00	23·09
35	1·22	3·13	90	12·00	30·78
40	1·48	3·80	95	15·15	38·86
45	1·78	4·57	100	18·60	47·71
50	2·13	5·46	...	...	...

(Scheibler and Sidersky.)

Sol. in cold NH_4Cl + Aq. (Rose.)

Sol. in an aqueous solution of cane sugar. (Hunton, Phil. Mag. (3) **11**. 156.)

Solubility in H_2O containing 10 g. sugar at t°.

t°	g. $SrO_2H_2+8H_2O$	t°	g. $SrO_2H_2+8H_2O$
3	3·10	24	4·79
15	3·79	40	9·70

(Sidersky, C. C. **1886**. 57.)

Strontium iodide, SrI_2.

100 pts. H_2O dissolve at:

0° 20° 40° 70° 100°
164 179 196 250 370 pts. SrI_2.

(Kremers, Pogg. **103**. 65.)

Sp. gr. of SrI_2 + Aq at 19·5° containing:

5 10 20 30 % SrI_2,
1·045 1·091 1·200 1·330
40 50 60 65 % SrI_2.
1·491 1·695 1·955 2·150

(Kremers, Pogg. **103**. 67; calculated by Gerlach, Z. anal. **8**. 285.)

Strontium stannous iodide.

Very sol. in H_2O. (Boullay.)

Strontium nitride, Sr_2N_3.

Decomp. H_2O violently, but not alcohol. (Maquenne, A. ch. (6) **29**. 225.)

Strontium oxide, SrO.

Decomp. by H_2O to SrO_2H_2, which see.

Sol. in 160 pts. H_2O at 15·56° (Dalton); in 50 pts. at 100° (Dalton); in 130 pts. at 20° (Bineau); in 40 pts. cold, and 20 pts. hot H_2O (Dumas).

Very sl. sol. in alcohol. Insol. in ether.
Sol. in cane sugar + Aq.

Solubility in H_2O containing 10 g. sugar at t°.

t°	g. SrO	t°	g. SrO
8	1·21	24	1·87
15	1·48	40	3·55

(Sidersky, C. C. **1886**. 57.)

Strontium *per*oxide, SrO_2.

Sl. sol. in H_2O. Easily sol. in acids and NH_4Cl + Aq. Insol. in NH_4OH + Aq. (Conroy, Chem. Soc. (2) **11**. 812.)
Cryst. with $8H_2O$, $10H_2O$, and $12H_2O$.

Strontium oxychloride, $SrCl_2$, $SrO + 9H_2O$.

Very easily decomp. by H_2O and alcohol. (André, A. ch. (6) **3**. 76.)

Strontium oxysulphide, $Sr_2OS_4 + 12H_2O$.

Decomp. by H_2O.
Insol. in alcohol, ether, and CS_2. (Schöne.)
Mixture of SrS_2O_3 and SrS_2. (Geuther, A. **224**. 178.)

Strontium phosphide.

Decomp. by H_2O.

Strontium selenide, SrSe.

Sl. sol. in H_2O. (Fabre, C. R. **102**. 1469.)

Strontium sulphide, SrS.

Sol. in H_2O with decomp. into SrO_2H_2 and SrS_2H_2.

Strontium *tetra*sulphide, SrS_4.

Very deliquescent, and sol. in H_2O and alcohol. Aqueous solution decomp. on air. Cryst. with 2, or $6H_2O$. (Schöne, Pogg. **117**. 58.)

Strontium *penta*sulphide, SrS_5.

Known only in solution.

Strontium stannic sulphide.

See **Sulphostannate, strontium.**

Sulphamic acid, $HOSO_2NH_2$.

See **Amidosulphonic acid.**

Ammonium sulphamate, $2NH_3$, SO_3.

(Woronin.)
Is ammonium imidosulphonate, which see. (Berglund.)

Ammonium sulphamate, acid, $3NH_3$, $2SO_3$.

(Woronin.)
Is basic ammonium imidosulphonate, which see. (Berglund.)

Barium sulphamate, basic, $2BaO$, $3SO_3$, $2NH_3$.

Somewhat sol. in H_2O, easily in HCl + Aq. (Jacquelain, A. ch. (3) **8**. 304.)

$BaS_2O_6(NH_2)_2$. Sl. sol. in H_2O. Decomp. by heating with H_2O. (Woronin, J. B. **1860**. 80.)
Is barium imidosulphonate. (Berglund.)

Sulphamide, $SO_2<\begin{matrix}NH_2\\NH_2\end{matrix}$.

See **Thionyl amide.**

$3NH_3$, $2SO_3$. (Jacquelain.)
Is basic ammonium imidosulphonate, which see. (Berglund.)

Sulphamidic acid.

(Fremy.)
See **Imidosulphonic acid.**

Sulphammonic, *and Meta*sulphammonic acids.

(Fremy.)
See **Nitrilosulphonic acid.**

*Mono*sulphammonic acid.

(Claus.)
See **Amidosulphonic acid.**

*Di*sulphammonic acid.

(Claus.)
See **Imidosulphonic acid.**

*Tri*sulphammonic acid.

(Claus.)
See **Nitrilosulphonic acid.**

*Tetra*sulphammonic acid.

(Claus.)
Does not exist. *See* **Nitrilosulphonic acid.**

Sulphantimonic acid.

Sulphantimonates.

The alkali sulphantimonates are sol. in H_2O, but the solutions decomp. on the air; most of the other sulphantimonates are insol. in H_2O; all sulphantimonates are insol. in alcohol. (Rammelsberg.)

Ammonium sulphantimonate, $(NH_4)_3SbS_4$.

Known only in solution.

Barium sulphantimonate, $Ba_3(SbS_4)_2 + 3H_2O$.

Sol. in H_2O. Insol. in alcohol.

Bismuth sulphantimonate.

Ppt.

Cadmium sulphantimonate.

Ppt. (Rammelsberg, Pogg. **52**. 236.)

Calcium sulphantimonate, $Ca_3(SbS_4)_2$.

Partially sol. in H_2O. Insol. in alcohol.

Cobaltous sulphantimonate, $Co_3(SbS_4)_2$.

Ppt. Decomp. by HCl + Aq. (Rammelsberg, Pogg. **52**. 236.)

Cupric sulphantimonate, $Cu_3(SbS_4)_2$.

Ppt. (Rammelsberg, Pogg. **52**. 226.)

Ferrous sulphantimonate.

Ppt.

Ferric sulphantimonate, $Fe_2(SbS_4)_2$.

(Rammelsberg, Pogg. **52**. 234.)

Lead sulphantimonate, $Pb_3(SbS_4)_2$.

Ppt. Decomp. by KOH+Aq. (Rammelsberg, Pogg. **52.** 223.)

Magnesium sulphantimonate, $Mg_3(SbO_4)_2$.

Deliquescent. Sol. in H_2O. Decomp. by alcohol.

Mercurous sulphantimonate, $(Hg_2)_3(SbS_4)_2$.

Ppt.

Mercuric sulphantimonate, $Hg_3(SbS_4)_2$.

Ppt. (Rammelsberg, Pogg. **52.** 229.)

Mercuric sulphantimonate chloride, $Hg_3(SbS_4)_2$, $3HgCl_2$, $3HgO$.

Insol. in acids, except aqua regia. (Rammelsberg.)

Nickel sulphantimonate, $Ni_3(SbS_4)_2$.

Ppt. Decomp. by hot HCl+Aq. (Rammelsberg, Pogg. **52.** 226.)

Potassium sulphantimonate, K_3SbS_4.

Sol. in H_2O.

$+4\frac{1}{2}H_2O$. Deliquescent. Sol. in H_2O; more sol. than the Na salt.

$2K_2S$, Sb_2S_3. Decomp. by cold H_2O. (Ditte, C. R. **102.** 168.)

K_2S, $2Sb_2S_3+3H_2O$. Sl. sol. in H_2O. (Ditte.)

K_2S, Sb_2S_3. Decomp. by H_2O. (Ditte.)

K_2S, $2Sb_2S_3$. (Ditte.)

Silver sulphantimonate, Ag_3SbS_4.

Insol. in H_2O or acids. Decomp. by KOH+Aq. (Rammelsberg, Pogg. **52.** 218.)

Sodium sulphantimonate, $Na_3SbS_4+9H_2O$.

(*Schlippe's salt.*) Sol. in 2·9 pts. H_2O at 15°. Aqueous solution is precipitated by alcohol. (Rammelsberg.)

Sol. in 3 pts. cold H_2O. (van den Corput.)

Sol. in 4 pts. cold H_2O. (Duflos.)

Sol. in 1 pt. boiling H_2O. (Duflos.)

Sodium sulphantimonate thiosulphate, Na_3SbS_4, $2Na_2S_2O_3+20H_2O$.

Efflorescent, and decomp. by H_2O. (Unger, Arch. Pharm. (2) **147.** 193.)

Strontium sulphantimonate.

Sol. in H_2O; pptd. by alcohol.

Uranium sulphantimonate.

Ppt.

Zinc sulphantimonate, $Zn_3(SbS_4)_2$.

Ppt. Sol. in hot Na_3SbS_4+Aq; insol. in $ZnSO_4$+Aq. Partially sol. in KOH+Aq; sol. in hot HCl+Aq. (Rammelsberg, Pogg. **52.** 233.)

Sulphantimonous acid.

Cuprous sulphantimonite, $Cu_2Sb_4S_7$.

Min. *Guejarite.*

$CuSbS_2$. Min. *Wolfsbergite.* Sol. in HNO_3+Aq with separation of S and Sb_2O_3.

Cuprous lead sulphantimonite, Cu_2SbS_3, $2Pb_2SbS_3$.

Min. *Bournonite.* Decomp. by HNO_3+Aq, and aqua regia.

Ferrous sulphantimonite, $Fe(SbS_2)_2$.

Min. *Berthierite.* Sl. sol. in HCl+Aq; easily sol. in aqua regia.

Lead sulphantimonite.

Sol. in boiling conc. HNO_3+Aq. (Fournet.)

$Pb(SbS_2)_2$. Min. *Zinckenite.* Decomp. by hot HCl+Aq.

$4PbS$, $3Sb_2S_3$. Min. *Plagionite.*

$2PbS$, Sb_2S_3. Min. *Jamesonite.* Decomp. by hot HCl+Aq.

$3PbS$, Sb_2S_3. Min. *Boulangerite.* Completely sol. in hot HCl+Aq; decomp. by HNO_3+Aq.

$4PbS$, Sb_2S_3. Min. *Meneghinite.*

$5PbS$, Sb_2S_3. Min. *Geokronite.*

$6PbS$, Sb_2S_3. Min. *Kibrickenite* (?).

Lead silver sulphantimonite, $(Ag_2, Pb)_5Sb_4S_{11}$.

Min. *Freieslebenite.*

Potassium sulphantimonite, $2K_2S$, Sb_2S_3.

Sol. in H_2O. (Ditte, C. R. **102.** 68.)

K_2S, $2Sb_2S_3+3H_2O$. Sol. in H_2O, but decomp. quickly.

xK_2S, ySb_2S_3. Deliquescent. When K_2S is in excess, sol. in H_2O; when Sb_2S_3 is in excess, partially sol. Aqueous solution is decomp. by all acids, even CO_2, and by K_2CO_3, Na_2CO_3, $NaHCO_3$, $KHCO_3$, NH_4HCO_3+Aq. Insol. in absolute alcohol. (Kohl.)

Silver sulphantimonite, Ag_3SbS_3.

Min. *Pyrargyrite.* Sol. in HNO_3+Aq with residue of S and Sb_2O_3. KOH+Aq dissolves out Sb_2S_3.

$AgSbS_2$. Min. *Miargyrite.*

$5Ag_2S$, Sb_2S_3. Min. *Stephanite.* Easily decomp. by warm HNO_3+Aq.

$12Ag_2S$, Sb_2S_3. Min. *Polyargyrite.*

Sodium sulphantimonite, $NaSbS_2$.

Deliquescent. Decomp. by hot H_2O. When Na_2S is in excess, sol. in H_2O, but partially sol. if Sb_2S_3 is in excess. (Unger, Arch. Pharm. (2) **148.** 1.)

$4Na_2S$, $3Sb_2S_3+3H_2O$. Permanent; sol. in H_2O. Insol. in alcohol and ether. (Kohl.)

*Ortho*sulpharsenic acid, H_3AsS_4.

Ppt. Loses H_2S by prolonged boiling with H_2O. (Nilson, J. pr. (2) **14.** 145.)

See also **Sulphoxyarsenic acid.**

Ammonium sulpharsenate, $(NH_4)_4As_2S_7$.

Known only in solution in H_2O. Decomp. on boiling into—

NH_4AsS_3. Sol. in alcohol.

$(NH_4)_3AsS_4$. Sol. in H_2O. Precipitated by alcohol.

$(NH_4)_2S$, $12As_2S_5$. Ppt. Insol. in H_2O.

Ammonium magnesium sulpharsenate, $(NH_4)_2S$, MgS, As_2S_5.

Ammonium sodium sulpharsenate, $(NH_4)_3AsS_4$, Na_3AsS_4.

Much more sol. in H_2O than Na_3AsS_4; sl. sol. in cold, more sol. in hot alcohol. (Berzelius.)

Barium sulpharsenate, $Ba(AsS_3)_2$.

Sol. in H_2O and alcohol. Decomp. by evaporation.

$Ba_2As_2S_7$. Sol. in H_2O in all proportions with decomp. Decomp. by alcohol.

$Ba_3(AsS_4)_2$. Sol. in H_2O. Insol. in alcohol.

$BaS, 3As_2S_5$. Ppt. Insol. in H_2O.

Barium sulpharsenate sulpharsenite, $Ba_3(AsS_4)_2, Ba_2As_2S_5+4H_2O$.

Sl. sol. in cold, more easily in hot H_2O. (Nilson.)

Bismuth sulpharsenate, $2Bi_2S_3, 3As_2S_5$.

Sol. in Na_3AsS_4+Aq.

$Bi_2S_3, 3As_2S_5$. As above. (Berzelius.)

Cadmium sulpharsenate.

Ppt. (Berzelius, Pogg. **7**. 88.)

Calcium sulpharsenate, $Ca_2As_2S_7$.

Sol. in H_2O and alcohol.

$Ca_3(AsS_4)_2$. Easily sol. in H_2O. Insol. in alcohol.

$+10H_2O$. Easily sol. in H_2O. (Nilson, J. pr. (2) **14**. 169.)

$5CaS, 2As_2S_5+6H_2O$. Easily sol. in H_2O. (Nilson, J. pr. (2) **14**. 163.)

Cerous sulpharsenate, $Ce_2As_2S_7$.

Ppt.

$Ce_3(AsS_4)_2$. Ppt.

$Ce_4(As_2S_7)_3$. Ppt.

Cobaltous sulpharsenate, $Co_2As_2S_7$.

Ppt. Sol. in excess of sodium sulpharsenate+Aq.

Cuprous sulpharsenate, Cu_3AsS_4.

Ppt. (Preis, A. **257**. 201.)

Min. *Enargite. Clarite.* Not wholly decomp. by HCl+Aq. Sol. in HCl+Aq with residue of As_2O_3. Not attacked by KOH+Aq.

Cupric sulpharsenate, $Cu_2As_2S_7$.

Ppt. Sol. in $(NH_4)_2S$+Aq. Decomp. by NH_4OH+Aq. (Berzelius.)

$Cu_3(AsS_4)_2$. Ppt. (Preis, A. **257**. 201.)

Glucinum sulpharsenate.

Sl. sol. in H_2O.

Gold sulpharsenate, $AuAsS_4$.

Sol. in pure H_2O. Insol. in Na_3AsS_4+Aq.

$2Au_2S_3, 3As_2S_5$. Sol. in H_2O. (Berzelius.)

Ferrous sulpharsenate, $Fe_2As_2S_7$.

Ppt. Sol. in Na_3AsS_4+Aq. (Berzelius.)

Ferric sulpharsenate, $Fe_4(As_2S_7)_3$.

Ppt. Sol. in Na_3AsS_4+Aq. (Berzelius.)

Lead sulpharsenate, $Pb_2As_2S_7$.

Ppt. (Berzelius.)

$Pb_3(AsS_4)_2$. Ppt.

Lithium sulpharsenate, Li_3AsS_4.

Easily sol. in hot, less sol. in cold H_2O. Insol. in alcohol.

$Li_4As_2S_7$. Completely sol. in H_2O. Decomp. by alcohol.

$LiAsS_3$. Known only in acid solution.

Magnesium sulpharsenate, $Mg_2As_2S_7$.

Sol. in all proportions of H_2O, and in alcohol.

$Mg_3(AsS_4)_2$. Sol. in H_2O. Decomp. by alcohol.

$3MgS, As_2S_5$. Nearly insol. in H_2O.

$5MgS, 2As_2S_5+15H_2O$. Very sol. in H_2O. (Nilson.)

Manganous sulpharsenate, $Mn_2As_2S_7$.

Sl. sol. in H_2O.

$Mn_3(AsS_4)_2$. Permanent. Sl. sol. in H_2O.

$6MnS, As_2S_5$. Sl. sol. in H_2O.

Mercurous sulpharsenate, $(Hg_2)_2As_2S_7$.

Ppt.

Mercuric sulpharsenate, $Hg_2As_2S_7$.

Ppt. (Berzelius, Pogg. **7**. 29.)

$Hg_3(AsS_4)_2$. Ppt. (Preis, A. **257**. 200.)

Nickel sulpharsenate, $Ni_3(AsS_4)_2$.

Ppt. Not decomp. by HCl+Aq. Sol. in Na_3AsS_4+Aq. (Berzelius.)

$2NiS, As_2S_5$. As above.

Potassium sulpharsenate, $KAsS_3$.

Known only in alcoholic solution.

$K_4As_2S_7$. Deliquescent. Sol. in H_2O, from which alcohol ppts. K_3AsS_4.

K_3AsS_4. Deliquescent. Very sol. in H_2O, from which it is precipitated by alcohol.

$+H_2O$. Very deliquescent. (Nilson, J. pr. (2) **14**. 159.)

Potassium sodium sulpharsenate.

Sol. in H_2O.

Silver sulpharsenate, Ag_3AsS_4.

Ppt. (Berzelius, Pogg. **7**. 29.)

$Ag_2As_2S_7$. Ppt.

Sodium sulpharsenate, $NaAsS_3$.

Known only in alcoholic solution.

$Na_4As_2S_7$. Sol. in H_2O. Alcohol ppts. Na_3AsS_4 from H_2O solution.

$Na_3AsS_4+7\frac{1}{2}H_2O$. Easily sol. in H_2O, from which it is precipitated by alcohol.

$+9H_2O$. (Nilson, J. pr. (2) **14**. 160.)

$Na_2S, 12As_2S_5$ (?). Insol. in H_2O.

Sodium zinc sulpharsenate, $NaZnAsS_4+4H_2O$.

Sol. in hot H_2O with decomp. (Preis, A. **257**. 202.)

Strontium sulpharsenate, $Sr_3(AsS_4)_2$.

Easily sol. in H_2O ; insol. in alcohol.

$Sr_2As_2S_7$. Easily sol. in H_2O, from which alcohol ppts. $Sr_3(AsS_4)_2$.

Strontium sulpharsenate sulpharsenite, $Sr_3(AsS_4)_2, Sr_2As_2S_5+4H_2O$.

Easily sol. in H_2O. (Nilson, J. pr. (2) **14**. 162.)

Stannous sulpharsenate.

Ppt.

Stannic sulpharsenate.

Ppt.

Uranic sulpharsenate, $2U_2S_3, As_2S_5$.

Ppt. Sol. in Na_3AsS_4+Aq.

Zinc sulpharsenate, $Zn_3(AsS_4)_2$.

Ppt. (Berzelius.)

$2ZnS, As_2S_5$. Ppt. (Berzelius.)

ZnS, As_2S_5. (Wöhler.)

*Di*sulpharsenic acid.

See ***Di*sulphoxyarsenic acid.**

Sulpharsenious acid.

Ammonium sulpharsenite, $NH_4As_3S_5+2H_2O$.

Insol. in H_2O. Ppt. Sol. in KOH or NH_4OH+Aq. Sl. attacked by boiling HCl+Aq. (Nilson, J. pr. (2) **14.** 42.)

$(NH_4)_4As_2S_5=2(NH_4)_2S, As_2S_3$. Sol. in H_2O, from which alcohol ppts. $(NH_4)_3AsS_3$.

$(NH_4)_3AsS_3=3(NH_4)_2S, As_2S_3$. Decomp. on air; sol. in H_2O. Insol. in alcohol.

$(NH_4)_5As_3S_{10}$. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 160.)

Barium sulpharsenite, $Ba_2As_2S_5$.

Sl. sol. in H_2O. Decomp. by alcohol.

$+5H_2O$. Sl. sol. in H_2O. (Nilson, J. pr. (2) **14.** 46.)

$+15H_2O$. Sl. sol. in cold H_2O. (Nilson.)

$Ba_3(AsS_3)_2$. Sl. sol. in H_2O. Precipitated by alcohol.

$+14H_2O$. Sl. sol. in cold, easily in hot H_2O. (Nilson.)

$Ba(AsS_2)_2+2H_2O$. Insol. in H_2O. (Nilson, J. pr. (2) **14.** 44.)

$BaAs_{12}S_{19}$. Insol. in HCl+Aq. (Nilson.)

Bismuth sulpharsenite, $2Bi_2S_3, As_2S_3$.

Ppt.

Cadmium sulpharsenite.

Ppt. (Berzelius, Pogg. **7.** 146.)

Calcium sulpharsenite, $Ca_2As_2S_5$.

Sol. in H_2O, from which alcohol ppts. $Ca_3(AsS_3)_2$.

$Ca_3(AsS_3)_2$. Sol. in H_2O.

$+15H_2O$. Precipitated by alcohol.

$Ca(AsS_2)_2+10H_2O$. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 54.)

$CaAs_8S_{13}+10H_2O$ (?). Insol. in cold H_2O. Decomp. by hot H_2O. (Nilson.)

$CaAs_{18}S_{28}+10H_2O$ (?). Sl. sol. in hot H_2O. (Nilson.)

$Ca_7As_2S_{10}+25H_2O$. Sl. sol. in cold or hot H_2O. (Nilson.)

Cerous sulpharsenite, $Ce_2As_2S_5$.

Ppt.

Chromic sulpharsenite, $2Cr_2S_3, 3As_2S_3$.

Ppt. Insol. in Na_2S+Aq.

Cobaltous sulpharsenite, $2CoS, As_2S_3$.

Ppt. Sol. in excess of sodium sulpharsenite+Aq.

Cuprous sulpharsenite,
$3Cu_2S, 2As_2S_3=Cu_6As_4S_9$.

Min. *Binnite.* Decomp. by hot acids and KOH+Aq.

Cupric sulpharsenite, Cu_3AsS_3.

Insol. in H_2O or HCl+Aq. Sol. in Na_3AsS_3+Aq.

$Cu_2As_2S_5$. Ppt. (Berzelius.)

Glucinum sulpharsenite, $2GlS, As_2S_3$.

Ppt. Sol. in acids; partly sol. in NH_4OH+Aq.

Gold sulpharsenite, $2Au_2S_3, 3As_2S_3$.

Ppt. (Berzelius.)

Ferrous sulpharsenite.

Ppt. Sol. in Na_3AsS_3+Aq. (Berzelius.)

Ferric sulpharsenite.

Ppt. Sol. in excess of a ferric salt, or Na_3AsS_3+Aq. (Berzelius.)

Lead sulpharsenite, $Pb_2As_2S_5$.

Ppt. Min. *Dufreynosite.*

$Pb(AsS_2)_2=PbS, As_2S_3$. Min. *Sartorite.*

$Pb_4As_2S_7$. Min. *Jordanite.*

Lithium sulpharsenites.

Resemble K salts.

Magnesium sulpharsenite, $Mg_2As_2S_5$.

Almost completely sol. in H_2O. Easily sol. in alcohol. (Berzelius.)

$+8H_2O$. Sl. sol. in H_2O. (Nilson.)

$Mg(AsS_2)_2+5H_2O$. Slowly sol. in both cold and hot H_2O. (Nilson, J. pr. (2) **14.** 59.)

$Mg_3(AsS_3)_2+9H_2O$. (Nilson.)

Manganous sulpharsenite, $Mn_2As_2S_5$.

Ppt. Decomp. by HCl+Aq.

Mercurous sulpharsenite, $(Hg_2)_2As_2S_5$.

Ppt. (Berzelius.)

Mercuric sulpharsenite, $Hg_2As_2S_5$.

Ppt.

$Hg(AsS_2)_2$. Ppt. (Berzelius, Pogg. **7.** 149.)

Nickel sulpharsenite, $Ni_3(AsS_3)_2$.

Ppt. (Berzelius.)

Platinum sulpharsenite, $Pt_2As_2S_5$.

Ppt.

Potassium sulpharsenite, $K_4As_2S_5$.

Decomp. by H_2O or alcohol. (Berzelius.)

K_3AsS_3. Sol. in H_2O. Insol. in alcohol. (Berzelius.)

$K_2As_4S_7$. Sol. in H_2O and alcohol. (Berzelius.)

K_2AsS_2. Decomp. by H_2O. (Berzelius.)

$+2\frac{1}{2}H_2O$. Not wholly sol. in H_2O. (Nilson, J. pr. (2) **14.** 30.)

$K_6As_4S_9+8H_2O$. (Nilson.)

$KAs_3S_5+H_2O$. Insol. in H_2O. Slowly attacked by hot HCl+Aq. Sol. in KOH+Aq. (Nilson.)

Silver sulpharsenite, $12Ag_2S, As_2S_3$.

Ag_3AsS_3. Min. *Proustite.* Sol. in HNO_3+Aq. KOH+Aq dissolves out Sb_2S_3. (Senarmont, A. ch. (3) **32.** 129; Wöhler, A. **27.** 159.)

$2Ag_2S, As_2S_3$. Partially sol. in HNO_3+Aq. (Berzelius.)

$AgAsS_2$. (Berzelius, Pogg. **7.** 150.)

Sodium sulpharsenite, $NaAsS_2+\frac{1}{2}H_2O$.

Attacked by HCl+Aq with difficulty. (Nilson, J. pr. (2) **14.** 37.)

$+1\frac{1}{2}H_2O$. Forms coagulum with cold, sol. in hot H_2O. (Nilson.)

$Na_2As_4S_7+6H_2O$. Sol. in much H_2O; not easily decomp. by HCl+Aq. (Nilson.)

$NaAs_3S_5+4H_2O$. Ppt. (Nilson, J. pr. (2) **14.** 3.)

Strontium sulpharsenite, $3SrS, As_2S_3+15H_2O$.
Sol. in H_2O+Aq; insol. in alcohol. (Voigt and Göttling.)
$2SrS, As_2S_3$. Sol. in H_2O; decomp. by alcohol.
$+15H_2O$. (Nilson, J. pr. (2) **14**. 53.)
$Sr(AsS_2)_2+2\frac{1}{2}H_2O$. Sl. sol. in H_2O. (Nilson.)

Thallous sulpharsenite, $TlAsS_2$.
Ppt. Decomp. by KOH+Aq. (Gunning, J.B. **1868**. 247.)

Stannous sulpharsenite, $Sn_2As_2S_5$.
Ppt.

Stannic sulpharsenite, $SnAs_2S_5$.
Ppt. (Berzelius, Pogg. **7**. 147.)

Uranic sulpharsenite, $2U_2S_3, As_2S_3$.
Ppt.

Zinc sulpharsenite.
Ppt. (Berzelius, Pogg. **7**. 145.)

Zirconium sulpharsenite, $2Zr_2S_3, As_2S_3$.
Ppt. Insol. in solutions of alkali sulpharsenites. Sl. sol. in Na_2S+Aq. Not decomp. by acids. (Berzelius.)

"Sulphatammon," $2NH_3, SO_3$.
(Rose.)
Is ammonium imidosulphonate, which see. (Berglund.)

"*Para*sulphatammon," $3NH_3, 2SO_3$.
(Rose.)
Is basic ammonium imidosulphonate, which see. (Berglund.)

Sulphatoiodic acid.

Potassium sulphatoiodate, $K_2HO_3SIO_4$ or $KIO_3, KHSO_4$.
Decomp. by H_2O. (Blomstrand, J. pr. (2) **40**. 317.)
See **Iodate sulphate, potassium.**

Sulphatooctamine cobaltic carbonate, $(SO_4)_2Co_2(NH_3)_8CO_3+4H_2O$.
Sol. in H_2O. (Vortmann and Blasberg, B. **22**. 2650.)
$(SO_4)Co_2(NH_3)_8(CO_3)_2+3H_2O$. Sol. in H_2O. (V. and B.)
See **Carbonatotetramine cobaltic sulphate.** (Jörgensen.)

Sulphatoplatinamine sulphate, $SO_4Pt(NH_3)_2SO_4+3H_2O$.
Easily sol. in H_2O. Sol. in H_2SO_4+Aq.

Sulphatoplatin*di*amine sulphate, $SO_4Pt(N_2H_6)_2SO_4+H_2O$.
Insol. in H_2O.

Sulphatopurpureocobaltic bromide, $Co(SO_4)(NH_3)_5Br$.
Sol. in H_2O, from which it is precipitated by conc. HBr+Aq. (Jörgensen, J. pr. (2) **25**. 94.)

—— **carbonate,** $[(SO_4)Co(NH_3)_5]_2CO_3+4H_2O$.
Sol. in H_2O. (Vortmann and Blasberg, B. **22**. 2648.)

Sulphatopurpureocobaltic chloroplatinate, $2Co(SO_4)(NH_3)_5Cl, PtCl_4+2H_2O$.
Sl. sol. in cold H_2O. (Jörgensen.)

—— **nitrate,** $Co(SO_4)(NH_3)_5(NO_3)$.
Somewhat sl. sol. in cold H_2O. (Jörgensen.)

—— **sulphate,** $[Co(SO_4)(NH_3)_5]_2SO_4+H_2O$.
Very easily sol. in H_2O. (Jörgensen, J. pr. (2) **25**. 94.)
$Co(SO_4)(NH_3)_5(HSO_4)+2H_2O$. Sol. in about 25 pts. of cold H_2O. Sol. in dil., insol. in conc. NH_4OH+Aq. (Jörgensen.)

Sulphazic acid, $H_4S_2N_2O_9=$ $SO_3H—N(OH)—O—N—(OH)SO_3H$.
Known only in its salts. (Raschig, A. **241**. 161.)

Potassium sulphazate, $K_3HS_2N_2O_9=$ $(SO_3K)(OK)N—O—N(OH)—(SO_3K)$.
Sol. in H_2O, but decomp. on standing. (Raschig, A. **241**. 161.)

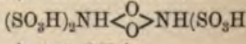
Sulphazidic acid.
(Fremy.)
See **Hydroxylamine *mono*sulphonic acid.**

Sulphazilinic acid.
See **Oxysulphazotic acid.**

***Meta*sulphazilinic acid.**
See ***Tri*sulphoxyazotic acid.**

Sulphazinous acid.
(Fremy.)
See ***Di*hydroxylamine sulphonic acid.**

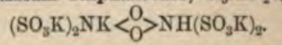
Sulphazotic acid, $H_6N_2S_4O_{14}=(SO_3H)_3\equiv NH—NO=OH(SO_3H)$.
Known only in its salts. (Claus, A. **158**. 52 and 194). Has the formula


$$(SO_3H)_2NH{<}\genfrac{}{}{0pt}{}{O}{O}{>}NH(SO_3H)_2.$$

(Raschig, A. **241**. 161.)

Lead potassium sulphazotate.
Insol. in cold, decomp. by hot H_2O. Insol. in alcohol and ether. (Fremy, A. ch. (3) **15**. 439.)

Potassium sulphazotate, $K_5HN_2S_4O_{14}+H_2O=$


$$(SO_3K)_2NK{<}\genfrac{}{}{0pt}{}{O}{O}{>}NH(SO_3K)_2.$$

Very sol. in hot, less in cold H_2O. (Raschig, A. **241**. 161.) Decomp. gradually by boiling. (Claus.) Insol. in alcohol or ether. (Fremy, A. ch. (3) **15**. 428.)
Forms basic salt $(SO_3K)_2NK{<}\genfrac{}{}{0pt}{}{O}{O}{>}NK(SO_3K)_2$, which is easily sol. and decomp. by H_2O. (Raschig.)

Potassium sodium sulphazotate, $K_4NaHN_2S_4O_{14}+2H_2O$.
Quite easily sol. in H_2O. (Raschig, A. **241**. 161.)

***Di*sulphhydroxyazotic acid,** $ONH(SO_3H)_2$.
Known only in its salts. (Claus, A. **158**. 52

and 194.) Correct composition is hydroxylamine sulphonic acid $HON(SO_3H)_2$, which see. (Raschig, A. **241.** 161.)

Sulphhydroxylamic acid.

(Claus.)

See **Hydroxylamine *mono*sulphonic acid.**

*Di*sulphhydroxyazotic acid.

(Claus.)

See **Hydroxylamine *di*sulphonic acid.**

Sulphides.

The sulphides of the alkali metals are sol. in H_2O; those of the alkali-earth metals are much less sol., and are decomp. upon solution into hydrosulphide and hydroxide.

The other sulphides are insol. in H_2O.

For each sulphide, see under the respective element.

Sulphimide, SO_2NH.

See **Thionyl imide.**

"Sulphitammon," NH_3, SO_2.

See **Thionamic acid.**

Sulphobismuthous acid.

Cuprous sulphobismuthite, $CuBiS_2$.

Min. *Emplectite.* Sol. in HNO_3+Aq.

$Cu_6Bi_4S_9$. Min. *Klaprothite.* Completely sol. in HCl+Aq.

Cu_3BiS_3. Min. *Wittichenite.* Sol. in HCl+Aq and in HNO_3+Aq.

Cuprous lead ——, Cu_2S, 2PbS, Bi_2S_3.

Min. *Patrinite.*

Sol. in HNO_3+Aq with residue of S and $PbSO_4$.

Lead ——, 2PbS, Bi_2S_3.

Min. *Cosalite.*

2PbS, $3Bi_2S_3$. Min. *Chiviatite.*

Sulphochromic acid, H_2CrO_4,SO_3 (?).

Sol. in H_2O. (Bolley, A. **56.** 113.)

Sulphochromous acid.

Ferrous sulphochromite, $FeCr_2S_4$.

Insol. in H_2O, and nearly so in HCl+Aq. (Gröger, W. A. B. **81, 2.** 531.)

Manganous ——, $MnCr_2S_4$.

Insol. in H_2O and HCl+Aq. (Gröger.)

Sodium ——, $Na_2Cr_2S_4$.

Insol. in H_2O. Sl. attacked by dil. HCl or H_2SO_4+Aq. Sol. in cold conc. HNO_3 or aqua regia. Sol. in hot dil. HNO_3+Aq. (Gröger.)

Zinc ——, $ZnCr_2S_4$.

Insol. in H_2O; sol. in traces in boiling conc. HCl or dil. H_2SO_4+Aq; sol. in HNO_3+Aq. (Gröger, W. A. B. **81, 2.** 531.)

Sulphocyanhydric acid, HSCN.

Sol. in H_2O.

Sat. HSCN+Aq has sp. gr.=1·022. (Porrett, **1814.**) HSCN+Aq containing 12·7 % HSCN has sp. gr. 1·040 at 12·7°. (Hermes, Z. Ch. **1866.** 417.)

Sulphocyanides.

Most sulphocyanides are sol. in H_2O, but Cu, Pb, Hg, and Ag sulphocyanides are insol.

Aluminum sulphocyanide, $Al(SCN)_3$.

Known only in solution.

$Al(SCN)_2(OH)_4$. Known only in solution. (Suida.)

Ammonium sulphocyanide, NH_4SCN.

Deliquescent, and very sol. in H_2O.

100 pts. H_2O dissolve 128·1 pts. at 0° and 162·2 pts. at 20°.

By dissolving 90 g. NH_4SCN in 90 g. H_2O at 17°, the temp. falls to −12°. (Clowes, Z. Ch. **1866.** 190.)

133 pts. NH_4SCN+100 pts. H_2O at 13·2° lower the temp. 31·2°. (Rüdorff, B. **2.** 68.)

Easily sol. in alcohol.

Easily sol. in acetone. (Krug and M'Elroy.)

Ammonium ferric sulphocyanide, $9NH_4SCN$, $Fe(SCN)_3+4H_2O$.

Deliquescent, and sol. in H_2O. (Krüss and Moraht, A. **260.** 207.)

$3NH_4SCN$, $Fe(SCN)_3$. Extremely deliquescent.

Ammonium mercuric sulphocyanide, $2NH_4SCN$, $Hg(SCN)_2$

Easily sol. in H_2O. (Fleischer, A. **179.** 228.)

Ammonium silver sulphocyanide, NH_4SCN, AgSCN.

Decomp. by H_2O.

Arsenic sulphocyanide, $As(SCN)_3$.

Decomp by H_2O. Insol. in all ordinary solvents. (Miguel, A. ch. (5) **11.** 341.)

Barium sulphocyanide, $Ba(SCN)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol. Boiling solution in alcohol contains 32·8 % anhydrous salt. Solution sat. at 20° contains 30 %. (Tscherniak, B. **16.** 349.)

Cryst. with $3H_2O$. (Tscherniak, B. **25.** 2627.)

Bismuth sulphocyanide, $Bi(SCN)_3$.

Insol. or sl. sol. in H_2O. Sol. in HNO_3, HCl, and HSCN+Aq. (Meitzendorf, Pogg. **56.** 83.)

Decomp. by cold H_2O. (Bender, B. **20.** 723.)

$Bi(SCN)_3$, $2Bi_2O_3$. Insol. in H_2O, but when recently pptd. decomp. by boiling therewith. Insol. in HSCN+Aq. (M.)

Cadmium sulphocyanide, $Cd(SCN)_2$.

Sl. sol. in H_2O. Sol. in NH_4OH+Aq with combination.

Calcium sulphocyanide, $Ca(SCN)_2+3H_2O$.

Deliquescent. Very sol. in H_2O and alcohol.

Cerous sulphocyanide, $Ce(SCN)_3+7H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Jolin, Bull. Soc. (2) **21.** 534.)

Chromic sulphocyanide, $Cr(SCN)_3$.

Deliquescent, and sol. in H_2O.

See also **Chromisulphocyanhydric**

Cobaltous sulphocyanide, $Co(SCN)_2+\frac{1}{2}H_2O$.

Sol. in H_2O and alcohol; also in ether.
Sol. in acetone. (Krug and M'Elroy.)

Cobaltous mercuric sulphocyanide, $Co(SCN)_2$, $Hg(SCN)_2$.

Very sl. sol. in H_2O and dil. HCl+Aq. Easily sol. in HNO_3+Aq. (Cleve, J. pr. **91.** 227.)

Cuprous sulphocyanide, $Cu_2(SCN)_2$.

Insol. in H_2O or dil. acids. Sl. sol. in cold, easily in warm conc. HCl+Aq. Decomp. by conc. H_2SO_4 or HNO_3+Aq. Sol. with combination in NH_4OH+Aq. Insol. in KSCN+Aq.

Cupric sulphocyanide, $Cu(SCN)_2$.

Decomp. by H_2O to cuprous salt. Sol. in warm HCl, H_2SO_4, or HNO_3+Aq. Sol. in MSCN+Aq, but solutions decomp. by dilution. Sol. in NH_4OH+Aq.

Cuprocupric sulphocyanide, $Cu(SCN)_2$, $Cu_2(SCN)_2$.

Not attacked by hot HCl+Aq. Insol. in KSCN+Aq.

Cuprous potassium sulphocyanide, $Cu_2(SCN)_2$, 12KSCN.

Sol. in H_2O. (Thurnauer, B. **23.** 770.)

Cupric sulphocyanide ammonia, $Cu(SCN)_2$, $2NH_3$.

Sol. in little H_2O, but decomp. by dilution with pptn. of basic salt. Sol. in NH_4OH+Aq.

Didymium sulphocyanide, $Di(SCN)_3+6H_2O$.

Deliquescent, and sol. in H_2O.

Erbium sulphocyanide, $Er(SCN)_3+6H_2O$.

Deliquescent. Sol. in H_2O. (Höglund.)

Glucinum sulphocyanide, $Gl(SCN)_2$ (?).

Sol. in H_2O. (Hermes, J. pr. **97.** 465.)

Aurous potassium sulphocyanide, AuSCN, KSCN.

Easily sol. in H_2O, less in absolute alcohol. (Cleve, J. pr. **94.** 16.)

Aurous silver sulphocyanide, AuSCN, AgSCN.

Insol. in H_2O. Sol. in NH_4OH+Aq.

Auric potassium sulphocyanide.

Sol. in H_2O, alcohol, and ether. (Cleve.)

Aurous sulphocyanide ammonia, AuSCN, NH_3.

Very sl. sol. in cold, decomp. by hot H_2O.

Ferrous sulphocyanide, $Fe(SCN)_2+3H_2O$.

Very sol. in H_2O, alcohol, or ether.
Sol. in acetone. (Krug and M'Elroy.)

Ferric sulphocyanide, $Fe(SCN)_3+3H_2O$.

Deliquescent. Very sol. in H_2O, alcohol, or ether. Ether extracts the salt from $Fe(SCN)_3$+Aq. Decomp. by much H_2O if pure. Not decomp. by monobasic acids, but conc. H_2SO_4, and H_3PO_4, also oxalic, tartaric, malic, etc., acids destroy the colour.

Ferric lithium sulphocyanide, $Fe(SCN)_3$, $9LiSCN+4H_2O$.

More deliquescent than the other ferric sulphocyanides. (Krüss and Moraht.)

Ferrous mercuric sulphocyanide, $Fe(SCN)_2$, $Hg(SCN)_2+2H_2O$.

Moderately sol. in hot H_2O. (Cleve, J. pr. **91.** 227.)

Ferric potassium sulphocyanide, $Fe(SCN)_3$, $3KSCN+xH_2O$.

Extremely deliquescent, and sol. in H_2O. (Krüss and Moraht.)

$Fe(SCN)_3$, $9KSCN+4H_2O$. Hygroscopic. Sol. in H_2O without decomp. Insol. in pure anhydrous ether, but decomp. by ether containing traces of H_2O into $Fe(SCN)_3$ and KSCN. (Krüss and Moraht, A. **260.** 204.)

Ferric sodium sulphocyanide, $Fe(SCN)_3$, $9NaSCN+4H_2O$.

Less deliquescent than the corresponding NH_4 or K salt. (Krüss and Moraht.)

Lanthanum sulphocyanide, $La(SCN)_3+7H_2O$.

Deliquescent; sol. in H_2O. (Cleve.)

Lithium sulphocyanide, LiSCN.

Very deliquescent. Sol. in H_2O and alcohol. (Hermes, Z. Ch. **1866.** 417.)

Lead sulphocyanide, $Pb(SCN)_2$.

Nearly insol. in cold, decomp. by boiling H_2O. (Liebig.)

$Pb(SCN)_2$, $PbO+H_2O$. Insol. in H_2O.

Lead sulphocyanide bromide, $Pb(SCN)_2$, $8PbBr_2$.

(Grissom and Thorp, Am. Ch. J. **10.** 219.)

Lead sulphocyanide chloride, $Pb_2Cl_2(CNS)_2$.

Sol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Lead sulphocyanide iodide, $3Pb(SCN)_2$, PbI_2.

Sol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Magnesium sulphocyanide, $Mg(SCN)_2+4H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Manganous sulphocyanide, $Mn(SCN)_2+3H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Mercurous sulphocyanide, $Hg_2(SCN)_2$.

Insol. in H_2O. Sol. in hot HCl+Aq. Slowly decomp. by hot aqua regia. Sol. in hot KSCN+Aq.

Mercuric sulphocyanide, basic, $Hg(SCN)_2$, 3HgO.

Insol. in H_2O. Easily sol. in HCl+Aq. Insol. in H_2SO_4 or HNO_3+Aq. (Fleischer.)

$Hg(SCN)_2$, 2HgO. Insol. in H_2O. Sl. attacked by acids. (Claus, J. pr. **15.** 401.)

Mercuric sulphocyanide, $Hg(SCN)_2$.

Very sl. sol. in cold, much more easily in hot H_2O. Easily sol. in dil. HCl+Aq. (Crookes, Chem. Soc. **4.** 18.)

Sol. in $Hg(NO_3)_2$ or $KSCN+Aq$, also in NH_4Cl+Aq. Sol. in many sulphocyanides $+Aq$.

Lead sulphocyanide chloride, $PbSCNCl$.

Sl. sol. in cold, easily sol. in hot H_2O. (Murtry, Chem. Soc. **55.** 50.)

Mercuric nickel sulphocyanide, $Hg(SCN)_2$, $Ni(SCN)_2+2H_2O$.

Moderately sol. in hot H_2O. (Cleve, J. pr. **91.** 227.)

Mercuric potassium sulphocyanide, $Hg(SCN)_2$, $KSCN$.

Sol. in cold, more easily in hot H_2O. Sol. in alcohol and ether. Very sol. in NH_4Cl or $KCl+Aq$. (Claus.)

Mercuric zinc sulphocyanide, $Hg(SCN)_2$, $Zn(SCN)_2$.

Scarcely sol. in cold H_2O. Easily sol. in $HCl+Aq$. (Cleve.)

Mercuric sulphocyanide ammonia, $2Hg(SCN)_2$, $3NH_3+\frac{1}{2}H_2O$.

Decomp. by H_2O and alcohol.

Molybdenum sulphocyanide, $Mo(SCN)_3$ (?).

Sol. in H_2O and ether. (Braun, Z. anal. **6.** 86.)

Nickel sulphocyanide, $Ni(SCN)_2+\frac{1}{2}H_2O$.

Sol. in H_2O and alcohol. Insol. in acetone. (Krug and M'Elroy.)

Nickel sulphocyanide ammonia, $Ni(SCN)_2$, $4NH_3$.

Decomp. by H_2O.

Platinous sulphocyanide, $Pt(SCN)_2$ (?).

Insol. in H_2O.

See **Platinosulphocyanides,** *and* **Platinososulphocyanides.**

Potassium sulphocyanide, $KSCN$.

Deliquescent. Very sol. in H_2O. 100 pts. H_2O dissolve 177·2 pts. at 0°, and 217·0 pts. at 20°.

150 pts. $KSCN+100$ pts. H_2O at 10·8° lower the temp. 34·5°. (Rüdorff, B. **2.** 68.)

Sol. in alcohol, especially easily if boiling.

Sol. in acetone. (Krug and M'Elroy.)

Potassium silver sulphocyanide, $KSCN$, $AgSCN$.

Decomp. by H_2O.

Silver sulphocyanide, $AgSCN$.

Insol. in H_2O or acids, excepting conc. H_2SO_4 or HNO_3. Insol. in dil., sol. in conc. NH_4OH+Aq. Sol. in $KSCN+Aq$. Insol. in $AgNO_3$ or $NH_4SCN+Aq$. Sol. in $Hg_2(NO_3)_2+Aq$.

Silver sulphocyanide ammonia, $AgSCN$, $2NH_3$.

Decomp. by H_2O.

Samarium sulphocyanide, $Sm(SCN)_3+6H_2O$.

Very deliquescent. (Cleve.)

Sodium sulphocyanide, $NaSCN$.

Very deliquescent. Very sol. in H_2O and alcohol.

Strontium sulphocyanide, $Sr(SCN)_2+3H_2O$.

Very deliquescent, and sol. in H_2O and alcohol.

Thallous sulphocyanide, $TlSCN$.

Sl. sol. in cold H_2O. Insol. in alcohol.

Stannous sulphocyanide, $Sn(SCN)_2$.

Sol. in H_2O and alcohol. (Clasen, J. pr. **96.** 349.)

Yttrium sulphocyanide, $Y(SCN)_3+6H_2O$.

Not deliquescent. Very sol. in H_2O, alcohol, or ether.

Zinc sulphocyanide, $Zn(SCN)_2$.

Less sol. in H_2O and alcohol than most other cyanides.

Zinc sulphocyanide ammonia, $Zn(SCN)_2$, $12NH_3$.

Decomp. by H_2O. Sol. in NH_4OH+Aq.

Sulphocyanoplatinic acid.

See **Platinosulphocyanhydric acid.**

Sulphocyanoplatinous acid.

See **Platinososulphocyanhydric acid.**

Sulphomolybdic acid.

Ammonium sulphomolybdate, $(NH_4)_2MoS_4$.

Easily sol. in H_2O; very sl. sol. in alcohol. (Berzelius, Pogg. **83.** 261.)

Ammonium cupric sulphomolybdate.

Sl. sol. in H_2O. (Debray, C. R. **96.** 1616.)

Barium sulphomolybdate, $BaMoS_4$.

More sol. in H_2O than $BaMo_3S_{10}$. Known only in solution. (Berzelius.)

BaS, $3MoS_3=BaMo_3S_{10}$. Sl. sol. in cold, easily sol. in hot H_2O. Not decomp. by conc. cold HNO_3+Aq, but more easily by dil. HNO_3+Aq. (Berzelius.)

Cadmium sulphomolybdate.

Insol. in H_2O. (Berzelius.)

Cæsium sulphomolybdate.

Easily sol. in H_2O. (Krüss, B. **19.** 2733.)

Calcium sulphomolybdate, CaS, $3MoS_3$.

Sol. in H_2O. (Berzelius.)

$CaMoS_4$. More sol. in H_2O than CaS, $3MoS_3$. Known only in solution. (Berzelius.)

Cerium sulphomolybdate.

Precipitate. (Berzelius.)

Cobalt sulphomolybdate, $CoMoS_4$.

Sol. in K_2MoS_4+Aq. (Berzelius.)

Cupric sulphomolybdate.

(Debray, C. R. **96.** 1616.)

Ferrous sulphomolybdate, $FeMoS_4$.

Sol. in H_2O. (Berzelius.)

Ferric sulphomolybdate, $Fe_2(MoS_4)_3$.

Sol. in K_2MoS_4+Aq.

Lead sulphomolybdate.

Ppt. (Berzelius.)

Lithium sulphomolybdate.

Not deliquescent, but very easily sol. in H_2O. (Berzelius.)

Magnesium sulphomolybdate, $MgMoS_4$.

Sol. in K_2MoS_4+Aq. (Berzelius.)

Manganous sulphomolybdate, $MnMoS_4$.

Sol. in H_2O. (Berzelius.)

Mercurous sulphomolybdate, Hg_2MoS_4 (?).

Ppt.

Mercuric sulphomolybdate, $HgMoS_4$.

Insol. in K_2MoS_4+Aq.

Nickel sulphomolybdate, $NiMoS_4$.

Sol. in K_2MoO_4+Aq. (Berzelius.)

Potassium sulphomolybdate, basic, $K_6Mo_2S_9$.

Easily sol. in H_2O. Insol. in alcohol and ether. (Krüss, B. **16**. 2050.)

Potassium sulphomolybdate, K_2MoS_4.

Sol. in H_2O, from which it is precipitated by alcohol. (Berzelius.)

Silver sulphomolybdate, Ag_2MoS_4.

Ppt.

Sodium sulphomolybdate, Na_2MoS_4.

Sol. in H_2O, and not precipitated by alcohol from aqueous solution. (Berzelius.)

Strontium sulphomolybdates.

Exactly analogous to the Ba salts, which see. (Berzelius.)

Zinc sulphomolybdate.

Ppt. Insol. in H_2O. (Berzelius.)

*Mono*sulphomolybdic acid.

Sodium *mono*sulphomolybdate, Na_2MoO_3S.

Rather hygroscopic. Sol. in H_2O; forms deep blue solution with H_2SO_4. Sol. in $HC_2H_3O_2+Aq$. (Krüss, A. **225**. 1.)

*Di*sulphomolybdic acid.

Ammonium *di*sulphomolybdate, $(NH_4)_2MoO_2S_2$.

Sl. sol. in cold, easily in hot H_2O. Insol. in sat. NH_4Cl+Aq and absolute alcohol.

Aqueous solution is decomp. by boiling. (Bodenstab, J. pr. **78**. 186.)

Potassium *di*sulphomolybdate, $K_2MoO_2S_2$.

Very sol. in H_2O and alcohol. Sol. in $HC_2H_3O_2+Aq$. (Krüss, B. **16**. 2046.)

*Tri*sulphomolybdic acid.

Ammonium hydrogen *tri*sulpho*pyro*molybdate, $NH_4HMo_2O_4S_3$.

Precipitate. Insol. in alcohol or CS_2. (Krüss, B. **16**. 2047.)

Potassium hydrogen *tri*sulpho*pyro*molybdate, $KHMo_2O_4S_3$.

Very easily sol. in H_2O. (Krüss, B. **16**. 2048.)

Sodium hydrogen *tri*sulpho*pyro*molybdate, $NaHMo_2O_4S_3$.

Precipitate. Much more sol. in H_2O than the NH_4 compound. (Krüss, B. **16**. 2047.)

Potassium sulphomolybdate, $K_8Mo_4S_9O_7$.

Sol. in H_2O, $HC_2H_3O_2$, and H_2SO_4. (Krüss, B. **17**. 1771.)

*Per*sulphomolybdic acid, H_2MoS_5.

Precipitate. Insol. in H_2O, alcohol, ether, CS_2, and acetic acid.

Decomp. slowly by hot H_2SO_4. Sol. in warm $KOH+Aq$, and cold K_2S+Aq. Not attacked by cold $KSH+Aq$, but dissolves on warming. (Krüss, B. **17**. 1773.)

Ammonium *per*sulphomolybdate, $(NH_4)_2MoS_5$.

Very sl. sol. in cold, more easily in hot H_2O. Insol. in NH_4OH+Aq. (Berzelius.)

Barium ——, $BaMoS_5$.

Insol. in boiling H_2O or dil. $HCl+Aq$. (Berzelius.)

Calcium ——.

Difficultly sol. in H_2O. (Berzelius.)

Cerium ——.

Precipitate. (Berzelius.)

Ferrous ——.

Insol. in Fe salts $+Aq$, but sol. in K_2MoS_5+Aq. (Berzelius.)

Ferric ——.

Ppt.

Lithium ——.

Sl. sol. in cold, easily sol. in hot H_2O. (Berzelius.)

Magnesium ——.

Insol. precipitate. (Berzelius.)

Nickel ——.

Ppt. .Sol. in K_2MoS_5+Aq, from which it separates in 24 hours. (Berzelius.)

Potassium ——, K_2MoS_5.

Almost insol. in cold, more sol. in hot H_2O. Insol. in cold $KOH+Aq$. (Berzelius.)

Potassium hydrogen ——, $KHMoS_5$.

Sol. in H_2O. (Krüss.)

Sodium ——, Na_2MoS_5.

Sl. sol. in cold, easily in hot H_2O. (Berzelius.)

Sodium hydrogen ——, $NaHMoS_5$.

(Krüss.)

Sulphopalladic acid.

Potassium palladious sulphopalladate, K_2S, Pd_2S, $PdS_2=K_2Pd_3S_4$.

Insol. in H_2O. Moderately conc. $HCl+Aq$ dissolves out K without evolution of H_2S. (Schneider, Pogg. **141**. 526.)

Silver sulphopalladate, Ag_2PdS_3.

(Schneider.)

Silver palladious sulphopalladate, Ag_2S, Pd_2S, $PdS_2=Ag_2Pd_3S_4$.

Extraordinarily stable. (Schneider.)

Sodium sulphopalladate, Na_2PdS_3.

Slowly sol. in H_2O. Insol. in alcohol. (Schneider, Pogg. **141**. 520.)

Sulphophosphide *of* M.

See **M. phosphosulphide.**

Sulphophosphamic acid, $PS\begin{smallmatrix}(OH)_2\\ NH_2\end{smallmatrix}$ (?).

See **Thiophosphamic acid.**

Sulphophospho*di*amic acid, $PS\begin{smallmatrix}OH\\ (NH_2)_2\end{smallmatrix}$ (?).

See **Thiophospho*di*amic acid.**

Sulphophospho*tri*amide, $PS(NH_2)_3$.

See **Thiophosphoryl *tri*amide.**

Sulphophosphoric acid, H_3PSO_3.

See **Thiophosphoric acid.**

H_3PS_4. Known only in its salts.

Antimony sulphophosphate, $SbPS_4$.

Insol. in H_2O, alcohol, ether, CS_2, HCl+Aq, dil. H_2SO_4+Aq, C_6H_6, or $HC_2H_3O_2$. Decomp. by boiling with conc. HNO_3+Aq, H_2SO_4, aqua regia, KOH, NaOH or NH_4OH+Aq. (Glatzel, B. **24.** 3886.)

Arsenic sulphophosphate, $AsPS_4$.

Insol. in H_2O, alcohol, HCl+Aq, etc. Decomp. by warm HNO_3, aqua regia, dil. H_2SO_4, also sol. in KOH or NH_4OH+Aq. (Glatzel, Z. anorg. **4.** 186.)

Bismuth sulphophosphate, $BiPS_4$.

Insol. in H_2O, alcohol, ether, CS_2, benzene, $HC_2H_3O_2$, or dil. H_2SO_4+Aq. Decomp. by boiling HCl+Aq, conc. H_2SO_4, HNO_3, or aqua regia; also by NaOH, KOH, or NH_4OH+Aq. (Glatzel, Z. anorg. **4.** 186.)

Cadmium sulphophosphate, $Cd_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, benzene, CS_2, and $HC_2H_3O_2$. Decomp. by hot HCl+Aq. Very sl. attacked by dil. H_2SO_4+Aq. Slowly sol. in hot HNO_3, rapidly in aqua regia, or hot conc. H_2SO_4. (Glatzel, Z. anorg. **4.** 186.)

Cuprous sulphophosphate, Cu_3PS_4.

Insol. in H_2O, alcohol, etc.; also in HCl or dil. H_2SO_4+Aq. Decomp. by HNO_3, aqua regia, etc., not by KOH or NaOH+Aq. (Glatzel.)

Ferrous sulphophosphate, $Fe_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, etc.; insol. in HCl or hot dil. H_2SO_4+Aq. Decomp. by HNO_3, aqua regia, or conc. H_2SO_4. Not attacked by KOH or NH_4OH+Aq. (Glatzel.)

Lead sulphophosphate, $Pb_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc. Decomp. by warm HCl+Aq, conc. HNO_3+Aq; not attacked by NH_4OH+Aq; sl. decomp. by KOH+Aq. (Glatzel.)

Manganous sulphophosphate, $Mn_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, benzene, CS_2, or $HC_2H_3O_2$. Not attacked by HCl+Aq. Sol. in HNO_3 or aqua regia, with separation of S. Not attacked by dil. H_2SO_4+Aq. (Glatzel, Z. anorg. **4.** 186.)

Mercuric sulphophosphate, $Hg_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc.; also in HCl, dil. HNO_3, or H_2SO_4+Aq. Not attacked by conc. HNO_3 or aqua regia; easily sol. in HNO_3+Br_2+Aq. (Glatzel.)

Nickel sulphophosphate, $Ni_3(PS_4)_2$.

As the ferrous salt. (Glatzel.)

Silver sulphophosphate, Ag_3PS_4.

Insol. in H_2O, alcohol, etc.; also in HCl, HNO_3, or dil. H_2SO_4+Aq. Decomp. by conc. H_2SO_4, and aqua regia. (Glatzel.)

Thallous sulphophosphate, Tl_3PS_4.

Insol. in H_2O, alcohol, etc. Sol. in HCl, dil. H_2SO_4+Aq, etc. Not attacked by NH_4OH+Aq; sl. decomp. by conc. KOH+Aq. (Glatzel.)

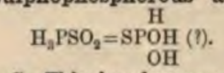
Stannous sulphophosphate, $Sn_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc. Insol. in dil. H_2SO_4 or HCl+Aq. Decomp. by HNO_3+Aq, aqua regia, NH_4OH, or KOH+Aq. (Glatzel.)

Zinc sulphophosphate, $Zn_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, etc. Sol. in HCl+Aq or dil. H_2SO_4+Aq. Easily attacked by KOH+Aq; sl. decomp. by NH_4OH+Aq. (Glatzel.)

Sulphophosphorous acid,



$$H_3PSO_2 = S\overset{H}{\underset{OH}{P}}OH\ (?).$$

See **Thiophosphorous acid.**

Sulphoplatinic acid, $H_2Pt_4S_6$.

Insol. in H_2O, but decomp. on air. (Schneider, Pogg. **138.** 604.)

$H_4Pt_3S_6$. Insol. in H_2O, but decomp. very rapidly on air. (Schneider.)

Copper sulphoplatinate, 2CuS, 2PtS, PtS_2.

Insol. in H_2O. HCl, HNO_3, or aqua regia dissolve out part of the Cu. (Schneider, Pogg. **139.** 661.)

Lead sulphoplatinate, 2PbS, 2PtS, PtS_2.

Insol. in hot or cold H_2O or HCl+Aq. HNO_3+Aq dissolves out Pb partly; aqua regia dissolves completely with difficulty. (Schneider, Pogg. **139.** 662.)

Mercuric sulphoplatinate chloride, 2HgS, 2PtS, PtS_2, $2HgCl_2$.

Insol. in H_2O; not attacked by HCl+Aq, and only partially sol. in boiling aqua regia. (Schneider.)

Potassium sulphoplatinate, $K_2Pt_4S_6$.

Insol. in H_2O. HCl+Aq dissolves out K without evolution of H_2S.

Composition is potassium platinous sulphoplatinate, K_2S, 3PtS, PtS_2. (Schneider, Pogg. **138.** 604.)

K_2PtS_2.

Silver sulphoplatinate, $2Ag_2S$, 2PtS, PtS_2.

Insol. in H_2O or HCl+Aq. HNO_3+Aq dissolves out Ag on warming. Aqua regia decomp. with formation of AgCl. (Schneider, Pogg. **138.** 664.)

Sodium sulphoplatinate, $Na_4Pt_3S_6 = 2Na_2S$, 2PtS, PtS_2.

Decomp. by hot H_2O, with residue of PtS_2. (Schneider.)

$Na_2Pt_3S_6 = Na_2S, PtS, 2PtS_2$. Insol. in H_2O. (Schneider, J. pr. (2) **48.** 418.)

Thallium sulphoplatinate, $2Tl_2S, 2PtS, PtS_2$.

Insol. in cold H_2O. Dil. acids dissolve out all the thallium. (Schneider, Pogg. **138.** 626.)

Sulphoplatinous acid, H_2PtS_2.

Known only in solution in H_2O, which soon decomposes. (Schneider, J. pr. (2) **48.** 424.)

Sodium sulphoplatinite, Na_2PtS_2.

Sol. in H_2O with decomp. (Schneider, J. pr. (2) **48.** 420.)

$H_4Na_2(PtS_2)_3$. Sol. in H_2O, from which it is pptd. by alcohol. (Schneider.)

Sulphoselenyl chloride, $SSeO_3Cl_4$.

Deliquescent; decomposed by H_2O. (Clausnitzer, B. **11.** 2007.)

Sulphostannic acid, H_2SnS_3.

Ppt. (Kühn, A. **84.** 110.)

Does not exist. (Storch, W. A. B. **98, 2b.** 236.)

Ammonium sulphostannate, $(NH_4)_2S, 3SnS_2 + 6H_2O$.

Easily sol. in H_2O, and easily decomp. (Ditte, C. R. **95.** 641.)

Barium sulphostannate, $BaSnS_3 + 8H_2O$.

Sol. in cold H_2O. (Ditte, C. R. **95.** 641.)

Calcium sulphostannate, $2CaS, SnS_2 + 14H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

***Tetra*platinous sulphostannate**, $4PtS, SnS_2$.

Not decomp. by acids. (Schneider, J. pr. (2) **7.** 214.)

Platinum potassium sulphostannate, $3PtS, K_2S, SnS_2$.

Insol. in cold H_2O. Dil. HCl or $HC_2H_3O_2$+Aq dissolves out all the potassium. (Schneider, Pogg. **136.** 109.)

Platinum sodium sulphostannate, $3PtS, Na_2S, SnS_2$.

Insol. in cold H_2O. (Schneider, Pogg. **136.** 109.)

Potassium sulphostannate, K_2SnS_3.

Sol. in H_2O. (Kühn, A. **84.** 110.)

$+3H_2O$. (Ditte, C. R. **95.** 641.)

Sodium sulphostannate, $Na_2SnS_3 + 2H_2O$.

Sl. sol. in H_2O. (Kühn, A. **84.** 110.)

$+3H_2O$. (Ditte, C. R. **95.** 641.)

$+7H_2O$. Sol. in H_2O. (Höring, Zeitsch. Pharm. **1851.** 120.)

$Na_4SnS_4 + 12H_2O$. Melts in crystal H_2O on heating. Very sol. in H_2O. (Kühn.)

Strontium sulphostannate, $SrSnS_3 + 12H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

*Di*sulphopersulphuric acid.

Sodium *di*sulphopersulphate, $Na_2S_4O_8$.

Sol. in H_2O. Cryst. in cold with $2H_2O$. (Villiers, C. R. **106.** 851, 1354.)

Contains 4H more and is sodium tetrathionate, $Na_2S_4O_6 + 2H_2O$. (Villiers, C. R. **108.** 402.)

Sulphotelluric acid.

Mercurous sulphotellurate, $3Hg_2S, TeS_2$.

Ppt.

Mercuric ——, $3HgS, TeS_2$.

Ppt. (Berzelius.)

Potassium ——, K_2TeS_4.

Sol. in H_2O. (Oppenheim, J. pr. **71.** 279.)

Sodium ——.

Sol. in H_2O. (Oppenheim.)

Sulphotellurous acid.

Ammonium sulphotellurite, $3(NH_4)_2S, TeS_2$

Decomp. on air. Sol. in H_2O.

Barium ——.

Very slowly sol. in H_2O.

Calcium ——.

Somewhat sol. in H_2O.

Cerium ——.

Insol. ppt.

Cobalt ——, Co_3TeS_5.

Ppt.

Copper ——, Cu_3TeS_5.

Ppt.

Ferrous ——.

Ppt.

Ferric ——.

Ppt.

Lead ——.

Ppt.

Lithium ——.

Sol. in H_2O.

Magnesium ——.

Sol. in H_2O and alcohol.

Manganous ——.

Ppt.

Potassium ——, $3K_2S, TeS_2$.

Sol. in H_2O.

Silver ——, $3Ag_2S, TeS_2$.

(Berzelius.)

Sodium ——.

Sol. in H_2O.

Strontium ——.

Sol. in H_2O.

Zinc ——, $3ZnS, TeS_2$.

Ppt. (Berzelius.)

Sulphotungstic acid.

Ammonium sulphotungstate, $(NH_4)_2WS_4$.

Very deliquescent. Easily sol. in H_2O, and still more easily in NH_4OH+Aq. (Corleis, A. **232.** 244.)

More sol. in pure H_2O than in H_2O acidified with HCl. Decomp. slowly on air. (Berzelius.)

Barium ——.

Sol. in BaS+Aq.

Cadmium sulphotungstate, $CdWS_4$.
Ppt. (Berzelius.)

Calcium ——.
Sol. in H_2O and alcohol. (Berzelius.)

Cobalt ——, $CoWS_4$.
Sl. sol. in H_2O.

Copper ——, $CuWS_4$.
Ppt.

Glucinum ——, $GlWS_4$.
Sol. in H_2O (?).

Ferrous ——, $FeWS_4$.
Sol. in H_2O.

Ferric ——.
Ppt.

Lead ——, $PbWS_4$.
Ppt. (Berzelius.)

Magnesium ——, $MgWS_4$.
Easily sol. in H_2O or alcohol.

Manganous ——, $MnWS_4$.
Sol. in H_2O. (Berzelius.)

Mercurous ——.
Ppt. (Berzelius.)

Mercuric ——, $HgWS_4$.
Ppt. (Berzelius.)

Nickel ——, $NiWS_4$.
Ppt. (Berzelius.)

Potassium ——, K_2WS_4.
Sol. in H_2O. Alcohol precipitates from aqueous solutions, but is not entirely insol. in alcohol. (Berzelius.)
Very sol. in H_2O. (Corleis, A. **232.** 264.)

Potassium —— nitrate, K_2WS_4, KNO_3.
Very sol. in cold or hot H_2O, from which it is precipitated by alcohol. (Berzelius.)

Potassium —— tungstate, $K_2WO_2S_2 = K_2WS_4$, K_2WO_4.
Easily sol. in H_2O. Not precipitated by alcohol. (Berzelius.)
Is potassium *tri*sulphotungstate, K_2WOS_3, which see. (Corleis, A. **232.** 244.)

Silver ——, Ag_2WS_4.
Ppt. (Berzelius.)

Sodium ——, Na_2WS_4.
Very sol. in H_2O; less sol. in alcohol. (Berzelius.)
Very deliquescent. (Corleis, A. **232.** 264.)

Strontium ——.
Sol. in H_2O, and in $SrS + Aq$.

Stannous ——, $SnWS_4$.
Ppt. (Berzelius.)

Stannic sulphotungstate, $SnWS_5$.
Ppt. (Berzelius.)

Zinc ——, $ZnWS_4$.
Sol. in H_2O with subsequent pptn. (Berzelius.)

*Mono*sulphotungstic acid.

Potassium *mono*sulphotungstate, $K_2WO_3S + H_2O$.
Deliquescent in moist air. Very sol. in H_2O. (Corleis, A. **232.** 244.)

*Di*sulphotungstic acid.

Ammonium *di*sulphotungstate, $(NH_4)_2WO_2S_2$.
Sol. in H_2O and alcohol. (Berzelius.)
Decomp. easily when moist. (Corleis, A. **232.** 264.)

*Tri*sulphotungstic acid.

Potassium *tri*sulphotungstate, $K_2WOS_3 + H_2O$.
Hygroscopic. Effloresces on dry air and easily decomposed. Easily sol. in H_2O. (Corleis, A. **232.** 244.)

Sulphovanadic acid, V_2O_5, $3SO_3 + 3H_2O$.

See **Vanadiosulphuric acid,** *and* **Sulphate, vanadium.**

Sulphovanadates.
Alkali sulphovanadates are sol. in H_2O. Ca, Sr, and Ba sulphovanadates are sl. sol. in H_2O, and all other sulphovanadates are insol. in H_2O. (Berzelius.)

Ammonium sulphovanadate, $(NH_4)_3VS_4$.
Easily sol. in H_2O. Very sl. sol. in conc. $NH_4SH + Aq$. Insol. in ether, CS_2, or $CHCl_3$. (Krüss and Ohnmais, A. **263.** 46.)
See also **Sulphoxyvanadic acid.**

Sulphoxyarsenic acid, H_3AsO_3S.

Known only in aqueous solution. (M'Cay, Am. Ch. J. **10.** 459.)

Barium *mono*sulphoxyarsenate, $BaHAsO_3 + 10H_2O$.
(Preis, A. **257.** 184.)

Barium *di*sulphoxyarsenate, $Ba_3(AsS_2O_2)_2 + 4H_2O$.
Ppt. (Preis, A. **257.** 185.)

Potassium sulphoxyarsenate, KH_2AsSO_3.
Sol. in H_2O; solution slowly decomp. on standing. (M'Cay, Am. Ch. J. **10.** 459.)
Formula given by Bouquet and Cloez (A. ch. (3) **13.** 44) was $K_2H_4As_2S_3O_5$.

Sodium *mono*sulphoxyarsenate, $Na_3AsSO_3 + 12H_2O$.
Easily sol. in H_2O. (Preis, A. **257.** 180.)
$Na_2HAsSO_3 + 8H_2O$. Easily sol. in H_2O. (Preis.)

Sodium *di*sulphoxyarsenate, $Na_3AsS_2O_2 + 10H_2O$.
Easily sol. in H_2O. (Preis.)

Sodium *tri*sulphoxy*di*arsenate, $As_2O_2S_3, 3Na_2O+24H_2O$.

Easily sol. in H_2O. (Geuther, A. **240.** 208.)

$2As_2O_2S_3, Na_2O+7H_2O$. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 14.)

Correct composition is $Na_8As_{18}S_{24}O_7+30H_2O$. (Preis.)

Sodium sulphoxyarsenate, $Na_8As_{18}S_{24}O_7+30H_2O=4Na_2O, 6As_2S_2, 3As_2S_4O+30H_2O$.

Decomp. by H_2O. Sol. in NH_4OH or $KOH+$ Aq. (Preis, A. **257.** 187.)

=Sodium oxy*tri*sulpharsenate of Nilson.

Sodium *penta*sulphoxy*tetr*arsenate, $Na_{12}As_4S_5O_{11}+48H_2O$.

Less sol. in H_2O than other sulphoxyarsenates. (Preis.)

*Tri*sulphoxyazotic acid, $ON(SO_3H)_3$.

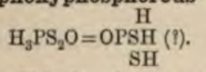
Known only in its salts. (Claus, **158.** 52 and 194.)

Has the formula $(SO_3H)_3N{<}{}^{O}_{O}{>}N(SO_3H)_3$. (Raschig, A. **241.** 161.)

Potassium *tri*sulphoxyazotate, $ON(SO_3K)_3+H_2O=(SO_3K)_3N{<}{}^{O}_{O}{>}N(SO_3K)_3$.

Easily sol. in H_2O, without decomp., even on boiling. (Claus, A. **157.** 210.)

Sulphoxyphosphorous acid,



$$H_3PS_2O=O\underset{SH}{\overset{H}{P}}SH\ (?).$$

See **Thiophosphorous acid.**

Sulphoxyvanadic acid.

Ammonium *pyrohexa*sulphoxyvanadate, $(NH_4)_4V_2S_6O$.

Sol. in H_2O. (Krüss and Ohnmais, A. **263.** 53.)

Potassium *pyrohexa*sulphoxyvanadate, $K_4V_2S_6O+3H_2O$.

Melts in crystal H_2O. (Krüss and Ohnmais.)

$K_8V_4S_{12}O_2+3H_2O$. More sol. in H_2O than preceding comp. (K. and O.)

Sodium *orthotri*sulphoxyvanadate, $Na_3VS_3O+5H_2O$.

Very deliquescent, and easily sol. in H_2O. Somewhat sol. in alcohol. (Krüss and Ohnmais.)

Sodium *orthomono*sulphoxyvanadate, $Na_3VSO_3+10H_2O$.

Less sol. in H_2O than other sulphoxyvanadates. (K. and O.)

Sulphur, S.

The various modifications of sulphur have been classified in many different ways, and there is a difference of opinion as to whether certain forms are true allotropic modifications or not.

The data, as far as concerns the solubility, may be arranged as follows:—

A. *Sol. in* CS_2. 1. Rhombic, octahedral, or alpha sulphur, ordinary sulphur. Easily sol. in CS_2, etc. *See* below for solubility in various solvents.

2. Prismatic, monoclinic, or beta sulphur. Sol. in CS_2, but is converted into A, 1. Prismatic sulphur obtained by melting brimstone is not wholly sol. in CS_2 on account of admixture of gamma sulphur.

3. Soft sulphur, milk of sulphur.

4. Amorphous sol. sulphur is also a separate modification, according to Berthollet.

B. Soft sulphur, obtained by strongly heating and quickly cooling, is sol. in CS_2, but becomes insol. therein by repeatedly dissolving and evaporating. More easily sol. in CS_2 than A, 1.

C. *Insol. in* CS_2. 1. By action of strong light on S in CS_2.

2. By heating to b.-pt., cooling suddenly, and allowing to stand until hard. Has been called gamma sulphur, but is a mixture of ⅔ A, 4 and ⅓ insol. S.

3. Insol. S in flowers of sulphur. Converted into A. 1 by standing 3 days with alcohol.

According to Berthelot (A. ch. (3) **49.** 430) there are only two varieties of S. I. "Octahedral," II. "Amorphous."

I. *Octahedral.* Sol. in CS_2. Scarcely acted upon by $KHSO_3+$ Aq. Converted by oxidising agents into II.

II. *Amorphous.* Insol. in neutral solvents, viz. H_2O, alcohol, ether, CS_2, etc.

Sol. with tolerable rapidity in $KHSO_3+$ Aq. By long action of Na_2S+ Aq, a portion is dissolved, and the remainder converted into I. Less easily oxidised by HNO_3+ Aq than I. Some varieties of this modification are sol. to a certain extent in alcohol and ether, and by boiling the rest of the sulphur is converted into I; also by long-continued contact with cold alcohol. Berthelot holds that the modification is changed before dissolving. Solutions of the alkalies, alkali salts, and alkali sulphides all change insol. into sol. sulphur. (Berthelot.)

Elastic sulphur obtained by pouring molten sulphur at a temp. of over 260° into H_2O contains 35 % or more of a modification of S which is insol. in CS_2, hot or cold, but sol. in absolute alcohol; this modification can be converted back into ord. sulphur by heating to 100°. (Pelouze and Fremy.) (*See* C. 2.)

This modification can be obtained also by action of HCl on thiosulphates. (Fordos and Gélis.)

The soft pasty sulphur obtained by decomposition of H_2S by SO_2 forms an almost clear emulsion (pseudo-solution) with H_2O, from which it is pptd. by various salts and substances which have no chemical affinity for it. 23 pts. S combine in this way with 100 pts. H_2O. When pptd. by saline solutions, some of the S remains in solution. When solution is exposed to the light, S gradually separates out; also on boiling the same takes place. The above pseudo-solution is pptd. by mineral acids, and the pptd. S may still be dissolved in fresh water, if not left in contact for some time with the acid. Also pptd. by K salts, with loss of power of forming pseudo-solutions. Pptd. by NH_4 and Na salts without losing that power. Alkali hydrates, carbonates, or sulphides convert it into insol. S.

The solution may be mixed with alcohol without change. Decomp. by long shaking with naphtha or oil of turpentine. The pseudo-solution combines with CS_2, forming an emulsion which subsequently decomposes. The S itself is only partially sol. in CS_2. (Selmi, J. pr. **57**. 49.)

"Delta" sulphur. Partly sol. in H_2O. (Debus, Chem. Soc. **53**. 18.)

A colloidal form wholly sol. in H_2O exists, which, however, decomposes very easily. (Engel, C. R. **112**. 866.)

Black sulphur. Insol. in alcohol, ether, CS_2, fatty oils even at 200°, cold alkali hydroxides +Aq, H_2SO_4, HNO_3, or aqua regia. (Knapp, J. pr. (2) **43**. 305.)

The following data relate to octahedral or ordinary sulphur (A. 1):—

Sol. in warm liquid H_2S (Niemann); warm P_2S_3, SBr_2, SCl_2, Br_2, NCl_3, BaS+Aq (Dumas); in alcoholic solution of K_2S_5, but is repptd. by addition of H_2O to sat. solution.

Sol. in liquid SO_2.

Sol. in aqueous solution of alkali sulphates, especially when hot. Sl. sol. in boiling conc. HSCN+Aq, from which it mostly separates on cooling.

Na_2CO_3+Aq (5·6 % Na_2CO_3) dissolves no S at 20°; 0·06775 % at 100°. (Pohl, Dingl. **197**. 508.)

S_2Cl_2 dissolves 66·74 % S at ord. temp. to form a liquid of 1·7 sp. gr. (Rose.)

Solubility in $SnCl_4$.

100 g. $SnCl_4$ dissolve at:

99°	101°	110°	110°	
5·8	6·2	8·7	9·1	pts. solid S,
112°	112°	121°		
9·4	9·9	17·0		pts. liquid S.

(Gerardin.)

Sol. in alkalies+Aq with decomp.

Sol. in 1926·7 pts. absolute alcohol at 15°. (Pohl, W. A. B. **6**. 600.)

Sol. in 20 pts. hot nearly absolute alcohol, less sol. in weaker alcohol. (Laurogais.)

Sol. in 600 pts. boiling alcohol of 40° B. (Chevallier, J. ch. méd. **2**. 587); in 500 pts. alcohol (Meissner); 200 pts. alcohol (Pelouze and Fremy).

100 pts. absolute methyl alcohol dissolve 0·048 pt. at 18·5°; 100 pts. absolute ethyl alcohol dissolve 0·053 pt. at 18·5°. (Bodländer, Z. phys. Ch. **7**.)

Solubility in amyl alcohol.

100 g. amyl alcohol dissolve at:

95°	110°	110°		
1·5	2·1	2·2		pts. solid S,
112°	112°	120°	131°	
2·6	2·7	3·0	5·3	pts. liquid S.

(Gerardin, A. ch. (4) **5**. 134.)

Quickly sol. in 12·5 pts. ether. (Favre.)

CS_2 dissolves 0·35 pt. ordinary sulphur; some varieties of S, however, are not entirely sol. in CS_2, thus—

Variety of Sulphur	Pts. sol. in 1 pt. CS_2	Fraction of original wt. insol. in CS_2
Octahedral, from Sicily	0·335	0·000
Crystallised in dry way, recently prepared	0·415	0·029
Do., prepared 8 years	0·33	0·004
Do., prepared 9 years	...	0·020
Do., prepared 15 years	...	0·051
Red needles, recently prepared	0·382	0·023
Soft yellow, do.	...	0·353
Do., prepared 2 years	0·316	0·157
Soft red, recently prepared	0·374	0·157
Do., prepared 5 years	...	0·181
Flowers of sulphur	0·351	0·113
Do., another sample	...	0·234
Roll brimstone, outside	...	0·029
Do., inside	...	0·073

(Deville, A. ch. (3) **47**. 99.)

The pt. insol. in CS_2 is sol. in hot absolute alcohol, crystallising on cooling; less sol. in chloroform or ether. (Deville.)

100 pts. pure CS_2 dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S
−11	16·54	22	46·05
− 6	18·75	38	94·57
0	23·99	48·5	146·21
+15	37·15	55	181·34
18·5	41·65	...	...

(Cossa, B. **1**. 138.)

When 20 pts. S dissolve in 50 pts. CS_2 at 22° the temp. is lowered 5°. (Cossa.)

Sat. solution of S in CS_2 boils at 55°. (Cossa.)

Sp. gr. of S dissolved in CS_2 at 15°.

Sp. gr.	% CS_2	Sp. gr.	% CS_2	Sp. gr.	% CS_2
1·271	0·0	1·289	4·4	1·307	8·7
1·272	0·2	1·290	4·6	1·308	8·9
1·273	0·4	1·291	4·8	1·309	9·2
1·274	0·6	1·292	5·1	1·310	9·4
1·275	0·9	1·293	5·3	1·311	9·7
1·276	1·2	1·294	5·6	1·312	9·9
1·277	1·4	1·295	5·8	1·313	10·2
1·278	1·6	1·296	6·0	1·314	10·4
1·279	1·9	1·297	6·3	1·315	10·6
1·280	2·1	1·298	6·5	1·316	10·9
1·281	2·4	1·299	6·7	1·317	11·1
1·282	2·6	1·300	7·0	1·318	11·3
1·283	2·9	1·301	7·2	1·319	11·6
1·284	3·1	1·302	7·5	1·320	11·8
1·285	3·4	1·303	7·8	1·321	12·1
1·286	3·6	1·304	8·0	1·322	12·3
1·287	3·9	1·305	8·[illegible]	[illegible]	[illegible]
1·288	4·1	1·306	[illegible]	[illegible]	[illegible]

Sp. gr. of S dissolved in CS_2 at 15°.—*Continued.*

Sp. gr.	% CS_2	Sp. gr.	% CS_2	Sp. gr.	% CS_2
1·325	13·1	1·348	18·6	1·370	25·1
1·326	13·3	1·349	18·9	1·371	25·6
1·327	13·5	1·350	19·0	1·372	26·0
1·328	13·8	1·351	19·3	1·373	26·5
1·329	14·0	1·352	19·6	1·374	26·9
1·330	14·2	1·353	19·9	1·375	27·4
1·331	14·5	1·354	20·1	1·376	28·1
1·332	14·7	1·355	20·4	1·377	28·5
1·333	15·0	1·356	20·6	1·378	29·0
1·334	15·2	1·357	21·0	1·379	29·7
1·335	15·4	1·358	21·2	1·380	30·2
1·336	15·6	1·359	21·5	1·381	30·8
1·337	15·9	1·360	21·8	1·382	31·4
1·338	16·1	1·361	22·1	1·383	31·9
1·339	16·4	1·362	22·3	1·384	32·6
1·340	16·6	1·363	22·7	1·385	33·2
1·341	16·9	1·364	23·0	1·386	33·8
1·342	17·1	1·365	23·2	1·387	34·5
1·343	17·4	1·366	23·6	1·388	35·2
1·344	17·6	1·367	24·0	1·389	36·1
1·345	17·9	1·368	24·3	1·390	36·7
1·346	18·1	1·369	24·8	1·391	37·2
1·347	18·4	...	...	...	...

(Macagno, C. N. **43**. 192.)

100 pts. absolute alcohol dissolve 0·42 pt. at b.-pt., and 0·12 pt. S at 16°; 100 pts. ether dissolve 0·54 pt. at b.-pt., and 0·19 pt. S at 16°; 100 pts. benzene dissolve 17·04 pts. at b.-pt., and 1·79 pts. S at 16°; 100 pts. oil of turpentine dissolve 16·16 pts. at b.-pt., and 1·35 pts. S at 16°; 100 pts. CS_2 dissolve 73·46 pts. at b.-pt., and 38·70 pts. S at 16°; 100 pts. naphtha dissolve 10·56 pts. at b.-pt., and 2·77 pts. S at 16°; 100 pts. tar-oil dissolve 26·98 pts. at b.-pt., and 1·51 pts. S at 16°. (Payen, C. R. **34**. 456.)

100 pts. benzene dissolve 0·965 pt. S at 26°; 100 pts. benzene dissolve 4·377 pts. S at 71°; 100 pts. toluene dissolve 1·479 pts. S at 23°; 100 pts. ethyl ether dissolve 0·972 pt. S at 23·5°; 100 pts. chloroform dissolve 1·205 pts. S at 22°; 100 pts. phenol dissolve 16·35 pts. S at 174°; 100 pts. aniline dissolve 85·27 pts. S at 130°. (Cossa, B. **1**. 139.)

Solubility in 100 pts. coal-tar oil at t°.

t°	Pts. S in		
	Oil of 0·870 sp. gr. B.-pt. 80-100°	Oil of 0·880 sp. gr. B.-pt. 85-120°	Oil of 0·882 sp. gr. B.-pt. 120-200°
15	2·1	2·3	2·5
30	3·0	4·0	5·3
50	5·2	6·1	8·3
80	11·8	13·7	15·2
100	15·2	18·7	23·0
110	...	23·0	26·2
120	...	27·0	32·0
130	...	...	38·7

Solubility in 100 pts., etc.—*Continued.*

t°	Pts. S in		
	Oil of 0·885 sp. gr. B.-pt. 150-200°	Oil of 1·010 sp. gr. B.-pt. 210-300°	Oil of 1·020 sp. gr. B.-pt. 220-300°
15	2·6	6·0	7·0
30	5·8	8·5	8·5
50	8·7	10·0	12·0
80	21·0	37·0	41·0
100	26·4	52·5	54·0
110	31·0	105·0	115·0
120	38·0	∞	∞
130	43·8	∞	∞

(Pelouze, C. R. **69**. 56.)

Easily sol. in boiling acetic anhydride. (Rosenfeld, B. **13**. 1475.)

Sol. in considerable amount in warm conc. $HC_2H_3O_2$ + Aq, but very sl. sol. if dil. (Liebermann, B. **10**. 866.)

Sol. in stearic acid + Aq. (Vulpius, Arch. Pharm. (3) **13**. 38.)

Acetic ether dissolves 6 % S. (Favre.)

Sol. in 12 pts. hot petroleum from Amiano, but nearly insol. in cold. (de Saussure.)

100 pts. nicotine at 100° dissolve 10·58 pts. S, but this separates out as the solution cools.

Sol. in warm aniline. (Barral, A. ch. (3) **20**. 352.)

Easily sol. in hot, less sol. in cold aniline. (Fritzsche.)

Very sol. in aniline and chinoline, especially when warm. (Hofmann.)

Sol. in 2·6 pts. of boiling, sl. sol. in cold creosote.

Sol. by digestion in 2 pts. oil of turpentine.

Sol. in hot oil of copaiba, crystallising on cooling.

Sol. in hot oil of mandarin, crystallising on cooling.

Sol. in hot oil of caraway, crystallising on cooling.

Somewhat sol. in hot, less in cold wood-spirit.

Sl. sol. in lignone, bromoform, cold benzene, but easily in hot benzene. (Mansfield, Chem. Soc. **1**. 262.)

Sol. in ethyl sulphide, and carbon chloride. (Rathke, A. **152**. 187.)

Sol. in mercuric methyl.

Sol. in 20 pts. ethyl nitrate, from which it is not pptd. by H_2O.

Very sl. sol. in cold acetone.

Sol. in naphtha, aldehyde, iodal, bromal, chloroform, warm chloral, sinkaline + Aq, ethyl chloride, warm benzoyl chloride.

100 pts. methylene iodide dissolve 10 pts. S at 10°. Melted sulphur is miscible with hot methylene iodide. (Retgers, Z. anorg. **3**. 343.)

S dissolves in 2000 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26**. 81.)

Glycerine dissolves 0·10 % S. (Klever, C. C. **1872**. 434.)

Sol. in butyl sulphydrate, and warm retinole.

Sol. in ethyl sulphydrate.

Very sol. in coniine, hexyl alcohol, warm allyl sulphocyanide, cacodyl oxide. Somewhat sol. in hot styrene, separating out on cooling.

Readily sol. in warm, less readily in cold toluene or resin-oil.

Sol. in olive oil at 115°, from which it mostly separates on cooling.

Sol. in hot oil of amber, crystallising upon cooling. Sol. in 2 pts. hot, sl. sol. in cold caoutchin.

Insol. in valerianic acid, amyl valerate, valeryl hydride.

Linseed oil dissolves % S at t°.

t°	% S	t°	% S	t°	% S
25	0·630	95	2·587	160	9·129
60	1·852	130	4·935	...	...

(Pohl.)

Solubility in olive oil (sp. gr. = 0·885).
100 pts. dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S	t°	Pts. S
15	2·3	65	20·6	110	30·3
40	5·6	100	25·0	130	43·2

(Pelouze, C. R. **68.** 1179.)

Sulphur bromide, S_2Br_2.

Decomp. gradually with H_2O. Dissolves S on warming, which crystallises out on cooling. Sol. in CS_2.

Decomp. by current of dry air into S and Br. (Hannay, Chem. Soc. **35.** 16.)

Sulphur *mono*chloride, S_2Cl_2.

Slowly decomp. by H_2O. Miscible with CS_2 and C_6H_6. Sol. in alcohol and ether with subsequent decomposition. Sol. in oil of turpentine.

Sulphur *di*chloride, SCl_2.

Decomp. slowly with H_2O, immediately by alcohol or ether.

Sulphur *tetra*chloride, SCl_4.

Violently decomp. by H_2O. Decomp. at temperatures above −22°. (Michaelis, A. **170.** 1.)

Sulphur stannic chloride, $2SCl_4$, $SnCl_4$.

Decomp. by H_2O. Sol. in dil. HNO_3+Aq. Forms a mass with fuming HNO_3 which is sol. in HNO_3+Aq. Sol. in $POCl_3$. (Casselmann.)

Sulphur titanium chloride, SCl_4, $2TiCl_4$.

Very deliquescent. Easily sol. in dil. HNO_3+Aq. (Weber, Pogg. **132.** 454.)

Sulphur chloride ammonia, S_2Cl_2, $4NH_3$.

Insol. in H_2O, but gradually decomp. thereby; sol. without decomp. in absolute alcohol, from which it is pptd. by H_2O. (Mertens.)

Does not exist. (Fordos and Gélis, C. R. **31.** 702.)

SCl_2, $2NH_3$. Decomp. by H_2O. Sol. in alcohol or ether. (Soubeiran, A. ch. **67.** 71.) Not a true chemical compound, but a mixture. (Fordos and Gélis, C. R. **31.** 702.)

SCl_2, $4NH_3$. Decomp. by H_2O. Sl. sol. in absolute alcohol and ether (Soubeiran, A. ch. **67.** 71); mixture (Fordos and Gélis).

Sulphur chloride nitrogen sulphide.

See **Nitrogen sulphochloride.**

Sulphur *mono*iodide, S_2I_2.

Insol. in H_2O. Decomp. by alcohol, which dissolves out I_2. Sl. sol. in cold caoutchin, the solution decomposing when boiled. Freely sol. in glycerine. Sol. in 60 pts. glycerine, and 82 pts. olive oil. (Cap and Garot, J. Pharm. (3) **26.** 81.)

Sulphur *hex*iodide, SI_6.

Decomp. on air. Alcohol or alkalies dissolve out iodine. (vom Rath, Pogg. **110.** 116.)

Does not exist. (M'Leod, Rep. Brit. Assn. Advn. Sci. **1892.** 690.)

Sulphur stannic iodide.

See **Tin sulphur iodide.**

Sulphur *sesqui*oxide, S_2O_3.

Deliquescent. Violently decomp. by H_2O at ordinary temp. Sol. in fuming H_2SO_4. Insol. in SO_3. Decomp. by alcohol or ether. (Weber, Pogg. **156.** 531.)

Sulphur *di*oxide, SO_2.

Liquid. Insol. in H_2O if brought in contact therewith below the b.-pt. of SO_2.

Sol. in 3 vols. CS_2 on warming, separating out on cooling. Dissolves some P, little S, and no sulphuric or phosphoric acids.

Dissolves ether, chloroform, P, Br, S, I, CS_2, colophonium, and other gums; also benzene when warmed. (Sestini, Bull. Soc. (2) **10.** 226.)

Miscible with liquid SO_3, but not with H_2SO_4.

Gas.

1 vol. H_2O absorbs 30 vols. SO_2 gas at 18° (Davy); 20 vols. at ord. temp. (Dalton); 43·78 vols. at ord. temp. (de Saussure); 50 vols. at 20° and 760 mm. (Pelouze and Fremy); 33 vols. at ord. temp. (Thomson).

1 pt. SO_2 (by weight) is sol. in 0·1429 pt. H_2O at 5°, and the solution has 1·020 sp. gr.

1 pt. SO_2 is sol. in 0·0400 pt. H_2O at ord. temp. (Priestley); in 0·0909 pt. H_2O at 16°, and sp. gr. of the solution = 1·0513 (Thomson).

Sol. in 2 pts. H_2O at 10°. (Pierre, A. ch. (3) **23.** 421.)

100 vols. H_2O at 18° and 760 mm. absorb 4378 vols. SO_2 gas; 100 vols. alcohol of 0·84 sp. gr. at 760 mm. absorb 11,577 vols. (de Saussure, **1814.**)

Solubility of SO_2 gas in H_2O. t° = temp.; V = vols. SO_2 reduced to 0° and 760 mm. contained in 1 vol. sat. SO_2+Aq; V_1 = vols. SO_2 gas reduced to 0° and 760 mm. dissolved by 1 vol. H_2O under 760 mm. pressure.

t°	V	V_1	t°	V	V_1
0	68·861	79·789	7	56·369	62·973
1	67·003	77·210	8	54·683	60·805
2	65·169	74·691	9	53·021	58·697
3	63·360	72·230	10	51·383	56·647
4	61·576	69·828	11	49·770	54·655
5	59·816	67·485	12	48·182	52·723
6	58·080	65·200	13	46·618	50·849

Solubility of SO_2 gas in H_2O, etc.—*Continued.*

t°	V	V_1	t°	V	V_1
14	45·079	49·033	28	27·754	29·314
15	43·564	47·276	29	26·788	28·210
16	42·073	45·578	30	25·819	27·161
17	40·608	43·939	31	24·873	26·151
18	39·165	42·360	32	23·942	25·178
19	37·749	40·838	33	23·025	24·244
20	36·206	39·374	34	22·122	23·347
21	34·986	37·970	35	21·234	22·489
22	33·910	36·617	36	20·361	21·668
23	32·847	35·302	37	19·502	20·886
24	31·800	34·026	38	18·658	20·141
25	30·766	32·786	39	17·827	19·435
26	29·748	31·584	40	17·013	18·766
27	28·744	30·422	...	...	...

(Schönfeld, A. **95.** 5.)

This table may be formulated as follows: 1 vol. H_2O absorbs $79{\cdot}789 - 2{\cdot}6077t + 0{\cdot}029349t^2$ vols. SO_2 at t° at temp. between 0° and 20°. 1 vol. sat. solution contains $68{\cdot}861 - 1{\cdot}87025t + 0{\cdot}01225t^2$ vols. SO_2 at t°. Coefficient of absorption between 21° and $40° = 75{\cdot}182 - 2{\cdot}1716t + 0{\cdot}01903t^2$, and 1 vol. sat. solution between 21° and 40° contains $60{\cdot}952 - 1{\cdot}38898t + 0{\cdot}00726t^2$ vols. SO_2.

Solubility of SO_2 in H_2O at various temps. and 760 mm. t° = temp.; G = grammes SO_2 dissolved in 1 g. H_2O; V = vols. SO_2 dissolved in 1 g. H_2O.

t°	G	V	t°	G	V
8	0·168	58·7	30	0·078	27·3
10	0·154	53·9	32	0·073	25·7
12	0·142	49·6	34	0·069	24·3
14	0·130	45·6	36	0·065	22·8
16	0·121	42·2	38	0·062	21·6
18	0·112	39·3	40	0·058	20·4
20	0·104	36·4	42	0·055	19·3
22	0·098	34·2	44	0·053	18·4
24	0·092	32·3	46	0·050	17·4
26	0·087	30·5	48	0·047	16·4
28	0·083	28·9	50	0·045	15·6

(Sims, A. **118.** 340.)

Solubility of SO_2 in H_2O at various pressures. P = "partial pressure," *i.e.* the total pressure minus the tension of aqueous vapour at given temp.; G at P = weight SO_2 in grammes, which is dissolved in 1 g. H_2O at pressure P; G at 760 = calculated weight SO_2 that would be contained in 1 g. H_2O at 760 mm. if the absorption were proportional to the pressure; V = the volume of G grammes of SO_2 at 0° and 760 mm.

Solubility of SO_2 in H_2O, etc.—*Continued.*

P	7°			
	G at P	G at 760	V at P	V at 760
30	0·010	0·263	3·634	92·06
40	0·013	0·242	4·451	84·55
50	0·015	0·223	5·129	77·95
60	0·017	0·218	6·024	76·28
70	0·020	0·213	6·868	74·55
80	0·022	0·210	7·743	73·55
90	0·025	0·208	8·598	72·62
100	0·027	0·205	9·421	71·60
120	0·032	0·201	11·09	70·20
140	0·036	0·197	12·71	69·00
160	0·041	0·195	14·34	68·15
180	0·046	0·193	15·97	67·40
200	0·050	0·191	17·59	66·83
220	0·055	0·190	19·19	66·30
240	0·059	0·188	20·79	65·84
260	0·064	0·187	22·40	65·44
280	0·069	0·186	23·99	65·10
300	0·073	0·185	25·59	64·81
350	0·085	0·184	29·55	64·16
400	0·096	0·182	33·51	63·65
450	0·107	0·181	37·44	63·25
500	0·118	0·180	41·42	62·94
550	0·130	0·179	45·31	62·60
600	0·141	0·178	49·20	62·32
650	0·152	0·178	53·10	62·09
700	0·163	0·177	56·98	61·86
750	0·174	0·176	60·88	61·69
760	0·176	0·176	61·65	61·65
800	0·185	0·176	64·74	61·50
850	0·196	0·175	68·57	61·30
900	0·207	0·175	72·41	61·15
950	0·218	0·175	76·25	61·00
1000	0·229	0·174	80·01	60·88
1050	0·240	0·174	83·97	60·77
1100	0·251	0·174	87·80	60·65
1200	0·273	0·173	95·45	60·45
1300	0·295	0·172	103·00	60·25

P	20°			
	G at P	G at 760	V at P	V at 760
40	0·007	0·143	2·637	50·09
50	0·009	0·138	3·171	48·20
60	0·011	0·135	3·718	47·10
70	0·012	0·131	4·205	45·64
80	0·013	0·127	4·663	44·30
90	0·015	0·125	5·169	43·65
100	0·016	0·124	5·692	43·25
120	0·019	0·121	6·683	42·33
140	0·022	0·119	7·690	41·75
160	0·025	0·118	8·666	41·17
180	0·028	0·117	9·652	40·75
200	0·030	0·116	10·62	40·35
220	0·033	0·115	11·59	40·03
240	0·036	0·114	12·54	39·70
260	0·038	0·112	13·45	39·30
280	0·041	0·112	14·41	39·10
300	0·044	0·111	15·34	38·87
350	0·050	0·110	17·66	38·35
400	0·059	0·109	20·56	38·10
450	0·064	0·108	22·37	37·77
500	0·071	0·107	24·67	37·50
550	0·077	0·106	26·93	37·20
600	0·083	0·105	29·14	36·90
650	0·090	0·105	31·39	36·70

Solubility of SO_2 in H_2O, etc.—*Continued.*

P	20°			
	G at P	G at 760	V at P	V at 760
700	0·096	0·105	33·62	36·50
750	0·103	0·104	35·94	36·43
760	0·104	0·104	36·43	36·43
800	0·110	0·104	38·32	36·40
1000	0·137	0·104	47·85	36·37
1300	0·178	0·104	62·10	36·31
1600	0·218	0·104	76·35	36·27
1900	0·259	0·104	90·53	36·21

P	39·8°			
	G at P	G at 760	V at P	V at 760
200	0·016	0·062	5·675	21·57
300	0·024	0·061	8·368	21·20
400	0·031	0·060	11·03	20·95
500	0·039	0·059	13·67	20·77
600	0·047	0·059	16·29	20·64
760	0·059	0·059	20·50	20·50
800	0·062	0·059	21·58	20·50
1000	0·077	0·058	26·84	20·40
1500	0·113	0·057	39·65	20·09
2000	0·149	0·057	52·11	19·80

P	50°			
	G at P	G at 760	V at P	V at 760
200	0·012	0·045	4·156	15·97
400	0·024	0·045	8·275	15·72
600	0·035	0·045	12·36	15·65
760	0·045	0·045	15·62	15·62
800	0·047	0·045	16·43	15·60
1000	0·059	0·045	20·51	15·59
1500	0·088	0·044	30·73	15·57
2000	0·012	0·044	39·07	15·55

(Sims, A. **118.** 340.)

Sp. gr. of sat. solution at—

0°	10°	20°	40°
1·06091	1·05472	1·02386	0·95548

(Bunsen and Schönfeld, A. **95.** 2.)

Sat. SO_2+Aq has sp. gr. = 1·0040. (Berthollet.)

Sp. gr. of sat. SO_2+Aq at t°.

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	1·0609	9	1·0548	17	1·0358
1	1·0596	10	1·0547	18	1·0321
2	1·0585	11	1·0528	19	1·0281
3	1·0576	12	1·0505	20	1·0239
4	1·0569	13	1·0481	21	1·0195
5	1·0562	14	1·0454	22	1·0147
6	1·0557	15	1·0424	23	1·0099
7	1·0552	16	1·0392	24	0·9991
8	1·0549	...	...	...	...

(Schiff, A. **107.** 312.)

Sp. gr. of SO_2+Aq at 4°.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1·0024	8	1·0217	15	1·0445
2	1·0049	9	1·0247	16	1·0480
3	1·0075	10	1·0278	17	1·0517
4	1·0102	11	1·0311	18	1·0553
5	1·0130	12	1·0343	19	1·0591
6	1·0158	13	1·0376	20	1·0629
7	1·0187	14	1·0410	21	1·0667

(Schiff, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of SO_2+Aq.

% SO_2	Temp.	Sp. gr.
0·99	15·5°	1·0051
2·05	,,	1·0102
2·87	,,	1·0148
4·04	,,	1·0204
4·99	,,	1·0252
5·89	,,	1·0297
7·01	,,	1·0353
8·08	,,	1·0399
8·68	,,	1·0438
9·80	,,	1·0492
10·75	,,	1·0541
11·65	12·5°	1·0597
13·09	11·0°	1·0668

(Giles and Schearer, Jour. Soc. Ch. Ind. **4.** 303.)

Sp. gr. of SO_2+Aq.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1·0052	4	1·0167	7	1·0283
2	1·0094	5	1·0208	8	1·0329
3	1·0134	6	1·0242	9	1·0402

(Anthon.)

Sp. gr. of SO_2+Aq.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1·0042	5	1·0210	8	1·0348
2	1·0083	6	1·0252	9	1·0392
3	1·0125	7	1·0295	10	1·0438
4	1·0167	...	...	...	...

(Hager, Adjumenta varia, Leipzig, **1876.** 146.)

Sp. gr. of SO_2+Aq at 15°.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
0·5	1·0028	4·0	1·0221	7·5	1·0401
1·0	1·0056	4·5	1·0248	8·0	1·0426
1·5	1·0085	5·0	1·0275	8·5	1·0450
2·0	1·0113	5·5	1·0302	9·0	1·0474
2·5	1·0141	6·0	1·0328	9·5	1·0497
3·0	1·0168	6·5	1·0353	10·0	1·0520
3·5	1·0194	7·0	1·0377	...	...

(Scott, Polyt. Centralbl. **1873.** 826.)

Conc. H_2SO_4 absorbs 0·009 pt. by weight (58 vols.), and SO_2 is more soluble in dilute H_2SO_4+Aq, the more H_2O there is present. (Kolb, Dingl. **209**. 270.)

Solubility in H_2SO_4.

Sp. gr. of H_2SO_4	Absorbs SO_2 per kg.	Absorbs SO_2 per litre
1·841	0·009	5·8
1·839	0·014	8·9
1·540	0·021	11·2
1·407	0·032	15·9
1·227	0·068	29·7
1·020	0·135	49·0

(Kolb, Bull. Soc. Ind. Mullhouse, **1872**. 224.)

Coefficient of absorption for H_2SO_4 (1·841 sp. gr. at 15° and 760 mm.) is 28·14 at 17°, and 28·86 at 16°. (Dunn, C. N. **43**. 121.)

Coefficient of absorption in H_2SO_4 (sp. gr. = 1·841) = 5·8; (sp. gr. = 1·839) = 8·9. (Lunge.)

Solubility of SO_2 in alcohol. 1 vol. alcohol at t° and 760 mm. dissolves V vols. SO_2 gas at 0° and 760 mm.

t°	V	t°	V	t°	V
0	328·62	9	201·33	17	130·61
1	311·98	10	190·31	18	124·58
2	295·97	11	179·91	19	119·17
3	280·58	12	170·13	20	114·48
4	265·81	13	160·98	21	110·22
5	251·67	14	152·45	22	106·68
6	238·16	15	144·55	23	103·77
7	225·26	16	137·27	24	101·47
8	212·98	...	...	...	...

(Bunsen's Gasometry.)

100 pts. absolute methyl alcohol dissolve 247 pts. SO_2 at 0° and 760 mm.; 47 pts. at 26° and 760 mm.; 100 pts. absolute ethyl alcohol dissolve 115 pts. SO_2 at 0° and 760 mm.; 32·3 pts. at 26° and 760 mm. (de Bruyn, Z. phys. Ch. **10**. 783.)

Sol. in ether.

Absorbed by oil of turpentine.

Rapidly absorbed by anhydrous aldehyde in the cold, 11 pts. aldehyde absorbing 19 pts. SO_2.

Absorption coefficient of aldehyde for SO_2 is 1·4 times greater than that of alcohol, and 7 times greater than that of H_2O. (Geuther and Cartmell, Proc. Roy. Soc. **10**. 111.)

1 pt. camphor dissolves 0·880 pt. by weight (=308 vols.) SO_2 at 0° and 725 mm.; 1 pt. glacial $HC_2H_3O_2$ dissolves 0·961 pt. by weight (=318 vols.) SO_2 at 0° and 725 mm.; 1 pt. formic acid dissolves 0·821 pt. by weight (=351 vols.) SO_2 at 0° and 725 mm.; 1 pt. acetone dissolves 2·07 pts. by weight (=589 vols.) SO_2 at 0° and 725 mm.; 1 pt. sulphuryl chloride dissolves 0·323 pt. by weight (=187 vols.) SO_2 at 0° and 725 mm. (Schulze, J. pr. (2) **24**. 168.)

Sulphur *tri*oxide, SO_3.

Fumes on air. Miscible with H_2O, with evolution of much heat. Sol. in H_2SO_4. Decomp. by alcohol and ether.

Exists in two modifications, one of which is liquid and miscible with H_2SO_4, while the solid form is only slowly sol. therein.

Miscible with CS_2 at 30°, but at 15° CS_2 dissolves only $\frac{1}{8}$ pt. SO_3, and SO_3, $\frac{1}{8}$ pt. CS_2. (Schultz-Sellack, Pogg. **139**. 480.)

There is only one modification, the liquid, which absorbs H_2O and becomes solid. (Rebs, A. **246**. 356.)

Miscible with liquid SO_2. (Schultz-Sellack.)

Sulphur *hept*oxide, S_2O_7.

Fumes on air. Slowly decomp. at 0°, instantaneously on warming. Sol. in conc. H_2SO_4. (Berthelot, J. pr. (2) **17**. 48.)

Forms compound S_2O_7, $2H_2O_2$.

Formula is SO_4, according to Traube (B. **24**. 1764), and S_2O_7 is SO_3+SO_4.

See also Marshall (Chem. Soc. **59**. 771).

Traube (B. **26**. 148) denies the existence of SO_4.

Sulphur oxychloride, $SOCl_2$.

See **Thionyl chloride.**

Sulphur oxy*tetra*chloride, $S_2O_3Cl_4$.

Violently decomp. by H_2O, dil. acids, or alcohol. (Millon, A. ch. (3) **29**. 327.)

Sol. in warm S_2Cl_2. (Carius, A. **106**. 295.)

Decomp. violently with CS_2.

Sulphur oxychloride, SO_2Cl.

See **Sulphuryl chloride.**

HSO_3Cl. *See* **Sulphuryl hydroxyl chloride.**

S_2OCl_4. Decomp. by H_2O and alcohol. (Ogier, C. R. **94**. 446.)

Probably only a mixture of $SOCl_2$ and SCl_2.

$S_2O_5Cl_2$. *See* ***Di*sulphuryl chloride.**

Sulphur *di*phosphide, P_2S.

See **Phosphorus *mono*sulphide.**

Sulphur *tetra*phosphide, P_4S.

See **Phosphorus *semi*sulphide.**

Sulphuretted hydrogen, H_2S.

See **Hydrogen sulphide.**

Sulphuric acid, H_2SO_4.

Miscible with H_2O in all proportions.

Sp. gr. of H_2SO_4+Aq.

Baumé degrees	Sp. gr.	% H_2SO_4	Baumé degrees	Sp. gr.	% H_2SO_4
66	1·842	100	66	1·844	100
60	1·725	84·22	60	1·717	82·34
55	1·618	74·32	55	1·618	74·32
50	1·524	66·45	54	1·603	72·70
45	1·466	58·02	53	1·586	71·17
40	1·375	50·41	52	1·566	69·30
35	1·315	43·21	51	1·550	68·03
30	1·260	36·52	50	1·532	66·45
25	1·210	30·12	49	1·515	64·37
20	1·162	24·01	48	1·500	62·80
15	1·114	17·39	47	1·482	61·32
10	1·076	11·73	46	1·466	59·85
5	1·023	6·60	45	1·454	58·02
(Vauquelin, A. ch. **76**. 260.)			(Darcet, A. ch. (2) **1**. 198.)		

Sp. gr. of H_2SO_4+Aq.

% H_2SO_4	Sp. gr. at 15°	Sp. gr. at 25°	% H_2SO_4	Sp. gr. at 15°	Sp. gr. at 25°
0	0·9986	0·9955	50	1·3866	1·3780
2·5	..	1·0115	55	1·4347	..
5	1·0284	1·0272	60	1·4860	1·4767
10	1·0659	1·0604	65	1·5402	..
15	1·0998	..	70	1·5946	1·5863
20	1·1378	1·3311	75	1·6534	..
25	1·1767	..	80	1·7092	1·6996
30	1·2154	1·2078	85	1·7602	..
35	1·2562	..	90	1·8050	1·7940
40	1·2976	1·2868	95	1·8318	..
45	1·3409	..	100	1·8406	1·8286

(Delezenne, **1823**.)

Sp. gr. at 15·56°, and b.-pt. of H_2SO_4+Aq.

Sp. gr.	% SO_3	B.-pt.	Sp. gr.	% SO_3	B.-pt.
1·850	81	326°	1·769	67	217°
1·849	80	318	1·757	66	210
1·848	79	310	1·744	65	205
1·847	78	301	1·730	64	200
1·845	77	293	1·715	63	195
1·842	76	285	1·699	62	190
1·838	75	277	1·684	61	186
1·833	74	268	1·670	60	182
1·827	73	260	1·650	58·6	177
1·819	72	253	1·520	50	143
1·810	71	245	1·408	40	127
1·801	70	238	1·300	30	115
1·791	69	230	1·200	20	107
1·780	68	224	1·100	10	103

(Dalton, N. Syst. **2**. 210.)

Sp. gr. of H_2SO_4+Aq at 15°.

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1·8485	81·54	100	1·3884	40·77	50
1·8460	79·90	98	1·3697	39·14	48
1·8410	78·28	96	1·3530	37·51	46
1·8336	76·65	94	1·3345	35·88	44
1·8233	75·02	92	1·3165	34·25	42
1·8115	73·39	90	1·2999	32·61	40
1·7962	71·75	88	1·2826	30·98	38
1·7774	70·12	86	1·2654	29·35	36
1·7570	68·49	84	1·2490	27·72	34
1·7360	66·86	82	1·2334	26·09	32
1·7120	65·23	80	1·2184	24·46	30
1·6870	63·60	78	1·2032	22·83	28
1·6630	61·97	76	1·1876	21·20	26
1·6415	60·34	74	1·1706	19·57	24
1·6204	58·71	72	1·1549	17·94	22
1·5975	57·08	70	1·1410	16·31	20
1·5760	55·45	68	1·1246	14·68	18
1·5503	53·82	66	1·1090	13·05	16
1·5280	52·18	64	1·0953	11·41	14
1·5066	50·55	62	1·0809	9·78	12
1·4860	48·92	60	1·0682	8·15	10
1·4660	47·29	58	1·0544	6·52	8
1·4460	45·66	56	1·0405	4·89	6
1·4265	44·03	54	1·0268	3·26	4
1·4073	42·40	52	1·0140	1·63	2

(Ure, Schw. J. **35**. 444.)

Sp. gr. of H_2SO_4+Aq.

Degrees Baumé	Sp. gr.	At 0°		At 15°	
		% SO_3	% H_2SO_4	% SO_3	% H_2SO_4
5	1·036	5·1	4·2	5·4	4·5
10	1·075	10·3	8·4	10·9	8·9
15	1·116	15·5	12·7	16·3	13·3
20	1·161	21·2	17·3	22·4	18·3
25	1·209	27·2	22·2	28·3	23·1
30	1·262	33·6	27·4	34·8	28·4
33	1·296	37·6	30·7	38·9	31·8

Sp. gr. of H_2SO_4+Aq—*Continued.*

Degrees Baumé	Sp. gr.	At 0°		At 15°	
		% SO_3	% H_2SO_4	% SO_3	% H_2SO_4
35	1·320	40·4	33·0	41·6	34·0
36	1·332	41·7	34·1	43·0	35·1
37	1·345	43·1	35·2	44·3	36·2
38	1·357	44·5	36·3	45·5	37·2
39	1·370	45·9	37·5	46·9	38·3
40	1·383	47·3	38·6	48·4	39·5
41	1·397	48·7	39·7	49·9	40·7
42	1·410	50·0	40·8	51·2	41·8
43	1·424	51·4	41·9	52·5	42·9
44	1·438	52·8	43·1	54·0	44·1
45	1·453	54·3	44·3	55·4	45·2
46	1·468	55·7	45·5	56·9	46·4
47	1·483	57·1	46·6	58·2	47·5
48	1·498	58·5	47·8	59·6	48·7
49	1·514	60·0	49·0	61·1	50·0
50	1·530	61·4	50·1	62·6	51·1
51	1·546	62·9	51·3	63·9	52·2
52	1·563	64·4	52·6	65·4	53·4
53	1·580	65·9	53·8	66·9	54·6
54	1·597	67·4	55·0	68·4	55·8
55	1·615	68·9	56·2	70·0	57·1
56	1·634	70·5	57·5	71·6	58·4
57	1·652	72·1	58·8	73·2	59·7
58	1·671	73·6	60·1	74·7	61·0
59	1·691	75·2	61·4	76·3	62·3
60	1·711	76·9	62·8	78·0	63·6
61	1·732	78·6	64·2	79·8	65·1
62	1·753	80·4	65·7	81·7	66·7
63	1·774	82·4	67·2	83·9	68·5
64	1·796	84·6	69·0	86·3	70·4
65	1·819	87·4	71·3	89·5	73·0
65·5	1·830	89·1	72·2	91·8	74·9
65·8	1·837	90·4	73·8	94·5	77·1
66	1·842	91·3	74·5	100·0	81·6
66·2	1·846	92·5	75·5	..	..
66·4	1·852	95·0	77·5	..	..
66·6	1·857	100·0	81·6	..	..

(Bineau, A. ch. (3) **26**. 124.)

The sp. gr. found at t° can be reduced to sp. gr. at 0° by multiplying by $\frac{144·38}{144·38 - t}$, or by using the following table. (Bineau.)

Correction of sp. gr. for temperature, to be added for a lowering of the temp. of 10°, or subtracted for a corresponding increase.

Sp. gr. of acid at 0°	Corr.	Sp. gr. of acid at 0°	Corr.	Sp. gr. of acid at 0°	Corr.
1·04	0·002	1·15	0·005	1·45	0·008
1·07	0·003	1·20	0·006	1·70	0·009
1·10	0·004	1·30	0·007	1·85	0·0096

(Bineau.)

Sp. gr. of H_2SO_4+Aq at 15°. a=%; b=sp. gr. if % is SO_3; c=sp. gr. if % is H_2SO_4.

a	b	c	a	b	c
1	1·009	1·0064	12	1·104	1·083
2	1·017	1·013	13	1·114	1·091
3	1·025	1·019	14	1·123	1·098
4	1·034	1·0256	15	1·133	1·106
5	1·041	1·032	16	1·142	1·1136
6	1·049	1·039	17	1·150	1·121
7	1·058	1·0464	18	1·160	1·129
8	1·067	1·0536	19	1·170	1·136
9	1·076	1·061	20	1·180	1·144
10	1·085	1·068	21	1·190	1·1516
11	1·095	1·0756	22	1·200	1·159

Sp. gr. of H_2SO_4, etc.—*Continued.*

a	b	c	a	b	c
23	1·210	1·167	62	1·689	1·523
24	1·220	1·174	63	1·701	1·534
25	1·229	1·182	64	1·716	1·545
26	1·239	1·190	65	1·730	1·557
27	1·248	1·198	66	1·742	1·578
28	1·258	1·2066	67	1·755	1·580
29	1·268	1·215	68	1·770	1·592
30	1·278	1·223	69	1·781	1·604
31	1·288	1·231	70	1·792	1·615
32	1·300	1·239	71	1·802	1·627
33	1·310	1·2476	72	1·810	1·639
34	1·320	1·256	73	1·819	1·651
35	1·332	1·264	74	1·825	1·663
36	1·344	1·272	75	1·830	1·675
37	1·354	1·281	76	1·834	1·686
38	1·367	1·289	77	1·837	1·698
39	1·378	1·2976	78	1·839	1·710
40	1·390	1·306	79	1·841	1·722
41	1·401	1·315	80	1·842	1·734
42	1·415	1·324	81	...	1·745
43	1·427	1·333	82	...	1·756
44	1·440	1·342	83	...	1·767
45	1·451	1·351	84	...	1·777
46	1·465	1·361	85	...	1·786
47	1·478	1·370	86	...	1·794
48	1·490	1·379	87	...	1·802
49	1·501	1·3886	88	...	1·809
50	1·517	1·398	89	...	1·816
51	1·530	1·408	90	...	1·822
52	1·545	1·418	91	...	1·827
53	1·556	1·428	92	...	1·831
54	1·573	1·438	93	...	1·834
55	1·585	1·448	94	...	1·8356
56	1·600	1·4586	95	...	1·8376
57	1·615	1·469	96	...	1·8384
58	1·627	1·480	97	...	1·840
59	1·642	1·490	98	...	1·8406
60	1·656	1·501	99	...	1·842
61	1·675	1·512	100	...	1·8426

(Bineau, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of H_2SO_4 + Aq at 15°; H_2O at 0° = 1.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
1	1·006	17	1·122	33	1·247
2	1·012	18	1·129	34	1·256
3	1·018	19	1·137	35	1·264
4	1·025	20	1·145	36	1·272
5	1·032	21	1·153	37	1·281
6	1·039	22	1·161	38	1·290
7	1·046	23	1·168	39	1·298
8	1·053	24	1·176	40	1·307
9	1·061	25	1·184	41	1·316
10	1·069	26	1·191	42	1·324
11	1·076	27	1·199	43	1·333
12	1·084	28	1·207	44	1·342
13	1·091	29	1·215	45	1·352
14	1·099	30	1·223	46	1·361
15	1·106	31	1·231	47	1·370
16	1·114	32	1·239	48	1·379

Sp. gr. of H_2SO_4, etc.—*Continued.*

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
49	1·389	67	1·580	84	1·773
50	1·399	68	1·592	85	1·783
51	1·409	69	1·604	86	1·792
52	1·418	70	1·615	87	1·800
53	1·428	71	1·626	88	1·807
54	1·438	72	1·638	89	1·814
55	1·448	73	1·650	90	1·820
56	1·459	74	1·662	91	1·825
57	1·469	75	1·674	92	1·8294
58	1·480	76	1·684	93	1·8339
59	1·491	77	1·697	94	1·8372
60	1·501	78	1·710	95	1·8390
61	1·512	79	1·721	96	1·8406
62	1·523	80	1·732	97	1·8410
63	1·535	81	1·743	98	1·8412
64	1·546	82	1·753	99	1·8403
65	1·558	83	1·763	100	1·8384
66	1·569	...	...	...	...

(From 1-91 % according to Kolb, calculated by Gerlach; from 92-100 % according to Lunge and Naef, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of H_2SO_4 at 15° compared with H_2O at 4° and 0 mm. pressure.

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1·000	0·07	0·09	1·175	19·69	24·12
1·005	0·68	0·83	1·180	20·21	24·76
1·010	1·28	1·57	1·185	20·73	25·40
1·015	1·88	2·30	1·190	21·26	26·04
1·020	2·47	3·03	1·195	21·78	26·68
1·025	3·07	3·76	1·200	22·30	27·32
1·030	3·67	4·49	1·205	22·82	27·95
1·035	4·27	5·23	1·210	23·33	28·58
1·040	4·87	5·96	1·215	23·84	29·21
1·045	5·45	6·67	1·220	24·36	29·84
1·050	6·02	7·37	1·225	24·88	30·48
1·055	6·59	8·07	1·230	25·39	31·11
1·060	7·16	8·77	1·235	25·88	31·70
1·065	7·73	9·47	1·240	26·35	32·28
1·070	8·32	10·19	1·245	26·83	32·86
1·075	8·90	10·90	1·250	27·29	33·40
1·080	9·47	11·60	1·255	27·76	34·00
1·085	10·04	12·30	1·260	28·22	34·57
1·090	10·60	12·99	1·265	28·69	35·14
1·095	11·16	13·67	1·270	29·15	35·71
1·100	11·71	14·35	1·275	29·62	36·29
1·105	12·27	15·07	1·280	30·10	36·87
1·110	12·82	15·71	1·285	30·57	31·45
1·115	13·36	16·36	1·290	31·04	38·03
1·120	13·89	17·01	1·295	31·52	38·61
1·125	14·42	17·66	1·300	31·99	39·19
1·130	14·95	18·31	1·305	32·46	39·77
1·135	15·48	18·96	1·310	32·94	40·35
1·140	16·01	19·61	1·315	33·41	40·93
1·145	16·54	20·26	1·320	33·88	41·50
1·150	17·07	20·91	1·325	34·35	42·08
1·155	17·59	21·55	1·330	34·80	42·66
1·160	18·11	21·19	1·335	35·27	43·20
1·165	18·64	22·83	1·340	35·71	43·74
1·170	19·06	23·47	1·345	36·14	44·28

Sp. gr. of H_2SO_4, etc.—*Continued.*

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1·350	36·58	44·82	1·660	60·11	73·64
1·355	37·02	45·35	1·665	60·46	74·07
1·360	37·45	45·88	1·670	60·82	74·51
1·365	37·89	46·41	1·675	61·20	74·97
1·370	38·32	46·94	1·680	61·57	75·42
1·375	38·75	47·47	1·685	61·93	75·86
1·380	39·18	48·00	1·690	62·29	76·30
1·385	39·62	48·53	1·695	62·64	76·73
1·390	40·05	49·06	1·700	63·00	77·17
1·395	40·48	49·59	1·705	63·35	77·60
1·400	40·91	50·11	1·710	63·70	78·04
1·405	41·33	50·63	1·715	64·07	78·48
1·410	41·76	51·15	1·720	64·43	78·92
1·415	42·17	51·66	1·725	64·78	79·36
1·420	42·57	52·15	1·730	65·14	79·80
1·425	42·96	52·63	1·735	65·50	80·24
1·430	43·36	53·11	1·740	65·86	80·68
1·435	43·75	53·59	1·745	66·22	81·12
1·440	44·14	54·07	1·750	66·58	81·56
1·445	44·53	54·55	1·755	66·94	82·00
1·450	44·92	55·03	1·760	67·30	82·44
1·455	45·31	55·50	1·765	67·65	82·88
1·460	45·69	55·97	1·770	68·02	83·32
1·465	46·07	56·43	1·775	68·49	83·90
1·470	46·45	56·90	1·780	68·98	84·50
1·475	46·83	57·37	1·785	69·74	85·10
1·480	47·21	57·83	1·790	69·96	85·70
1·485	47·57	58·28	1·795	70·45	86·30
1·490	47·95	58·74	1·800	70·94	86·90
1·495	48·34	59·22	1·805	71·50	87·60
1·500	48·73	59·70	1·810	72·08	88·30
1·505	49·12	60·18	1·815	72·69	89·05
1·510	49·51	60·65	1·820	73·51	90·05
1·515	49·89	61·12	1·821	73·63	90·20
1·520	50·28	61·59	1·822	73·80	90·40
1·525	50·66	62·06	1·823	73·96	90·60
1·530	51·04	62·53	1·824	74·12	90·80
1·535	51·43	63·00	1·825	74·29	91·00
1·540	51·78	63·43	1·826	74·49	91·25
1·545	52·12	63·85	1·827	74·69	91·50
1·550	52·46	64·26	1·828	74·86	91·70
1·555	52·79	64·67	1·829	75·03	91·90
1·560	53·12	65·08	1·830	75·19	92·10
1·565	53·46	65·49	1·831	75·35	92·30
1·570	53·80	65·90	1·832	75·53	92·52
1·575	54·13	66·30	1·833	75·72	92·75
1·580	54·46	66·71	1·834	75·96	93·05
1·585	54·80	67·13	1·835	76·27	93·43
1·590	55·18	67·59	1·836	76·57	93·80
1·595	55·55	68·05	1·837	76·90	94·20
1·600	55·93	68·51	1·838	77·23	94·60
1·605	56·30	68·97	1·839	77·55	95·00
1·610	56·68	69·43	1·840	78·04	95·60
1·615	57·05	69·89	1·8405	78·33	95·95
1·620	57·40	70·32	1·8415	79·19	97·00
1·625	57·75	70·74	1·8410	79·76	97·70
1·630	58·09	71·16	1·8415	80·16	98·20
1·635	58·43	71·57	1·8400	80·57	98·70
1·640	58·74	71·99	1·8400	80·98	99·20
1·645	59·10	72·40	1·8395	81·18	99·45
1·650	59·45	72·88	1·8390	81·39	99·70
1·655	59·78	73·23	1·8385	81·59	99·95

(Lunge and Isler, Zeit. angew. Ch. **9**. 129.)

Sp. gr. of conc. $H_2SO_4 + Aq$ at 15°.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
100	1·8384	95·74	1·8416
99·98	1·8385	95·67	1·8415
99·96	1·8386	95·61	1·8414
99·94	1·8387	95·55	1·8413
99·92	1·8388	95·50	1·8412
99·90	1·8389	95·45	1·8411
99·88	1·8390	95·40	1·8410
99·86	1·8391	95·35	1·8409
99·84	1·8392	95·30	1·8408
99·81	1·8393	95·25	1·8407
99·78	1·8394	95·21	1·8406
99·76	1·8395	95·16	1·8405
99·73	1·8396	95·12	1·8404
99·70	1·8397	95·08	1·8403
99·67	1·8398	95·04	1·8402
99·64	1·8399	95·00	1·8401
99·61	1·8400	94·96	1·8400
99·58	1·8401	94·92	1·8399
99·55	1·8402	94·88	1·8398
99·52	1·8403	94·84	1·8397
99·49	1·8404	94·81	1·8396
99·46	1·8405	94·77	1·8395
99·43	1·8406	94·73	1·8394
99·40	1·8407	94·69	1·8393
99·37	1·8408	94·65	1·8392
99·33	1·8409	94·61	1·8391
99·29	1·8410	94·57	1·8390
99·25	1·8411	94·53	1·8389
99·22	1·8412	94·49	1·8388
99·19	1·8413	94·46	1·8387
99·16	1·8414	94·42	1·8386
99·11	1·8415	94·38	1·8385
99·06	1·8416	94·34	1·8384
99·02	1·8417	94·31	1·8383
98·98	1·8418	94·27	1·8382
98·94	1·8419	94·24	1·8381
98·84	1·8420	94·20	1·8380
98·84	1·8421	94·17	1·8379
98·78	1·8422	94·13	1·8378
98·71	1·8423	94·10	1·8377
98·63	1·8424	94·07	1·8376
98·56	1·8425	94·03	1·8375
98·48	1·8426	94·00	1·8374
98·40	1·8427	93·97	1·8373
98·32	1·8428	93·93	1·8372
98·22	1·8429	93·90	1·8371
98·08	1·8430	93·87	1·8370
97·85	1·8431	93·83	1·8369
97·50	1·8432	93·80	1·8368
97·10	1·8431	93·77	1·8367
96·93	1·8430	93·74	1·8366
96·76	1·8429	93·71	1·8365
96·65	1·8428	93·68	1·8364
96·55	1·8427	93·65	1·8363
96·46	1·8426	93·62	1·8362
96·39	1·8425	93·59	1·8361
96·31	1·8424	93·56	1·8360
96·24	1·8423	93·53	1·8359
96·16	1·8422	93·50	1·8358
96·09	1·8421	93·47	1·8357
96·02	1·8420	93·44	1·8356
95·95	1·8419	93·41	1·8355
95·88	1·8418	93·38	1·8354
95·81	1·8417	93·35	1·8353

Sp. gr. of conc. H_2SO_4, etc.—*Continued.*

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
93·32	1·8352	91·68	1·8287
93·29	1·8351	91·65	1·8286
93·26	1·8350	91·63	1·8285
93·23	1·8349	91·61	1·8284
93·20	1·8348	91·59	1·8283
93·17	1·8347	91·56	1·8282
93·14	1·8346	91·54	1·8281
93·12	1·8345	91·52	1·8280
93·09	1·8344	91·50	1·8279
93·06	1·8343	91·47	1·8278
93·00	1·8342	91·45	1·8277
92·98	1·8341	91·43	1·8276
92·95	1·8339	91·41	1·8275
92·93	1·8338	91·39	1·8274
92·90	1·8337	91·37	1·8273
92·87	1·8336	91·35	1·8272
92·84	1·8335	91·32	1·8271
92·82	1·8334	91·30	1·8270
92·79	1·8333	91·28	1·8269
92·77	1·8332	91·26	1·8268
92·73	1·8331	91·24	1·8267
92·71	1·8330	91·22	1·8266
92·69	1·8329	91·20	1·8265
92·66	1·8328	91·18	1·8264
92·63	1·8327	91·16	1·8263
92·61	1·8326	91·14	1·8262
92·59	1·8325	91·12	1·8261
92·56	1·8324	91·10	1·8260
92·54	1·8323	91·08	1·8259
92·52	1·8322	91·06	1·8258
92·49	1·8321	91·04	1·8257
92·46	1·8320	91·02	1·8256
92·44	1·8319	91·00	1·8255
92·41	1·8318	90·98	1·8254
92·39	1·8317	90·96	1·8253
92·37	1·8316	90·94	1·8252
92·34	1·8315	90·92	1·8251
92·32	1·8314	90·90	1·8250
92·29	1·8313	90·88	1·8249
92·27	1·8312	90·86	1·8248
92·24	1·8311	90·84	1·8247
92·22	1·8310	90·82	1·8246
92·19	1·8309	90·80	1·8245
92·17	1·8308	90·78	1·8244
92·15	1·8307	90·76	1·8243
92·12	1·8306	90·74	1·8242
92·10	1·8305	90·72	1·8241
92·07	1·8304	90·70	1·8240
92·05	1·8303	90·68	1·8239
92·02	1·8302	90·66	1·8238
92·00	1·8301	90·64	1·8237
91·98	1·8300	90·62	1·8236
91·95	1·8299	90·60	1·8235
91·93	1·8298	90·59	1·8234
91·91	1·8297	90·57	1·8233
91·88	1·8296	90·55	1·8232
91·86	1·8295	90·53	1·8231
91·84	1·8294	90·51	1·8230
91·81	1·8293	90·49	1·8229
91·78	1·8292	90·47	1·8228
91·76	1·8291	90·46	1·8227
91·74	1·8290	90·44	1·8226
91·72	1·8289	90·42	1·8225
91·70	1·8288	90·40	1·8224

Sp. gr. of conc. H_2SO_4, etc.—*Continued.*

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
90·38	1·8223	90·17	1·8211
90·37	1·8222	90·15	1·8210
90·35	1·8221	90·13	1·8209
90·33	1·8220	90·11	1·8208
90·31	1·8219	90·10	1·8207
90·29	1·8218	90·08	1·8206
90·28	1·8217	90·06	1·8205
90·26	1·8216	90·04	1·8204
90·24	1·8215	90·02	1·8203
90·23	1·8214	90·01	1·8202
90·20	1·8213	89·99	1·8201
90·18	1·8212	89·97	1·8200

(Richmond [calculated from Pickering, Chem. Soc. **57**. 64], Jour. Soc. Ch. Ind. **9**. 479.)

Sp. gr. of conc. H_2SO_4+Aq at 15°.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
90	1·8185	96	1·8406
*90·20	1·8195	97	1·8410
91	1·8241	*97·70	1·8413
*91·48	1·8271	98	1·8412
92	1·8294	*98·39	1·8406
*92·83	1·8334	*98·66	1·8409
93	1·8339	99	1·8403
94	1·8372	*99·47	1·8395
*94·84	1·8387	100	1·8384
95	1·8390	*100·35	1·8411
*95·97	1·8406	...	...

* Determined by experiment.

(Lunge and Naef, Dingl. **248**. 91.)

Boiling-point of H_2SO_4+Aq.

% H_2SO_4	B.-pt.	% H_2SO_4	B.-pt.
5	101·0°	70	170·0°
10	102·0	72	174·5
15	103·5	74	180·5
20	105·0	76	189·0
25	106·5	78	199·0
30	108·0	80	207·0
35	110·0	82	218·5
40	114·0	84	227·0
45	118·5	86	238·5
50	124·0	88	251·5
53	128·5	90	262·5
56	133·0	91	268·0
60	141·5	92	274·5
62·5	147·0	93	281·5
65	153·5	94	288·5
67·5	161·0	95	295·0

(Lunge, B. **11**. 370.)

Freezing- and melting-points of H_2SO_4+Aq.

Sp. gr. at 15°	F.-pt.	M.-pt.
1·671	liq. at −20°	...
1·691	,,	...
1·712	,,	...
1·727	−7·5	−7·5
1·732	−8·5	−8·5
1·749	−0·2	+4·5
1·767	+1·6	+6·5
1·790	+4·5	+8·0
1·807	−9·0	−6·0
1·822	liq. at −20°	...
1·842	,,	...

(Lunge, B. **15**. 2644.)

Miscible with alcohol, with evolution of heat and formation of ethylsulphuric acid.

$+H_2O = H_4SO_5$, also called tetrahydroxyl sulphuric acid. (Marignac, A. ch. (3) **39**. 184.)

$+2H_2O = H_6SO_6$, also called perhydroxyl sulphuric acid.

Sulphuric acid, anhydrous, SO_3.

See **Sulphur *tri*oxide.**

***Di*sulphuric (*Pyro*sulphuric) acid**, $H_2S_2O_7$.

Very deliquescent. Miscible with H_2O. Sol. in fuming H_2SO_4. Miscible in liquid SO_2. (Schultz-Sellack.)

$H_2S_2O_7$, $2H_2SO_4$. Fumes on air. (Jacquelain, A. ch. (3) **30**. 343.)

***Tetra*sulphuric acid**, $H_2S_4O_{13}$.

Fumes on air. (Weber, Pogg. **159**. 313.)

Sulphates.

Most sulphates are easily sol. in H_2O; but Ag_2SO_4, Hg_2SO_4, and $CaSO_4$ are only sl. sol., while $BaSO_4$, $SrSO_4$, and $PbSO_4$ are nearly insol. therein. All sulphates are sol. in conc. H_2SO_4. Basic sulphates are insol. in H_2O. Most sulphates are insol. in alcohol.

Aluminum sulphate, basic, $2Al_2O_3$, SO_3+10H_2O.

Insol. in H_2O; easily sol. in cold dil. mineral acids, and $HC_2H_3O_2$+Aq. (Crum, A. **89**. 174.)

Min. *Felsöbanyite.*

$+12H_2O$.

$+15H_2O$. Min. *Paraluminite.*

$8Al_2O_3$, $5SO_3+25H_2O$. Insol. in H_2O; sol. in dil. acids. (Löwe, J. pr. **79**. 428.)

$5Al_2O_3$, $3SO_3+20H_2O$. Easily sol. in acids. (Debray, Bull. Soc. (2) **7**. 9.)

$3Al_2O_3$, $2SO_3+9H_2O$. Nearly insol. in conc. H_2SO_4. (Bayer, Dingl. **263**. 211.)

$+20H_2O$. Ppt.

$4Al_2O_3$, $3SO_3+36H_2O$. Easily sol. in dil. mineral acids, and hot $HC_2H_3O_2$+Aq. (Debray, Bull. Soc. (2) **7**. 1.)

Al_2O_3, $SO_3+6H_2O=(AlO)_2SO_4+H_2O$. Insol. in H_2O or $HC_2H_3O_2$+Aq. Sl. sol. in hot HCl, easily sol. in warm KOH+Aq. (Böttinger, A. **244**. 225.)

$+9H_2O$. (Athanasesco, C. R. **103**. 27.)

Min. *Aluminite.*

$3Al_2O_3$, $4SO_3+9H_2O$. (Athanasesco, C. R. **103**. 271.)

$+30H_2O$. Sol. in 144 pts. cold, and 30·8 pts. boiling H_2O. Easily sol. in HCl, and HNO_3+Aq. (Rammelsberg, Pogg. **43**. 583.)

$2Al_2O_3$, $3SO_3$. Decomp. by H_2O into $3Al_2O_3$, SO_3 and $Al_2(SO_4)_3$. (Maus.)

Al_2O_3, $2SO_3=Al_2O(SO_4)_2$.

Min. *Alumiane.*

$+H_2O$. Sol. in small quantity of H_2O, but decomp. by a large quantity into $(AlO)_2SO_4$ and $Al_2(SO_4)_3$. (Maus, Pogg. **11**. 80.)

$+12H_2O$. Easily sol. in hot or cold H_2O. Sat. solution contains 45 % salt at 15°, which crystallises unchanged on evaporating. (Marguerite, C. R. **90**. 354.)

Above basic compounds are mixtures. (Pickering, C. N. **45**. 121, 133, 146.)

Aluminum sulphate, $Al_2(SO_4)_3$.

100 pts. H_2O dissolve (*a*) pts. $Al_2(SO_4)_3$, and (*b*) pts. $Al_2(SO_4)_3+18H_2O$ at:

	0°	10°	20°	30°	40°	50
a	31·3	33·5	36·15	40·36	45·73	52·13
b	86·85	95·8	107·35	127·6	167·6	201·4

	60°	70°	80°	90°	100°
a	59·09	66·23	73·14	80·83	89·11
b	262·6	348·2	467·3	678·8	1132.

(Poggiale, A. ch. (3) **8**. 467.)

Hydrous salt is scarcely sol. in alcohol. (Berzelius.)

Sp. gr. of $Al_2(SO_4)_3$+Aq.

% $Al_2(SO_4)_3$	Sp. gr. at			
	15°	25°	35°	45°
5	1·0569	1·0503	1·045	1·0356
10	1·1071	1·1022	1·096	1·085
15	1·1574	1·1522	1·146	1·1346
20	1·2074	1·2004	1·192	1·1801
25	1·2572	1·2483	1·2407	1·2295

(Reuss, B. **17**. 2888.)

Sp. gr. of $Al_2(SO_4)_3$+Aq at 15° containing:

10	20	30	% $Al_2(SO_4)_3+18H_2O$,
1·0535	1·1105	1·1710	

40	50	% $Al_2(SO_4)_3+18H_2O$.
1·2355	1·3050	

Sp. gr. of sat. solution=1·34.

(Gerlach, Z. anal. **28**. 493.)

$Al_2(SO_4)_3$ is completely pptd. from $Al_2(SO_4)_3$+Aq by an excess of glacial $HC_2H_3O_2$. (Persoz, A. ch. (2) **63**. 444.)

$+8H_2O$. (Marguerite - Delarcharbonny, C. R. **112**. 229.)

$+10H_2O$. Deliquescent. (v. Hauer, W. A. B. **13**. 449.)

$+16H_2O$. (M.-D., C. R. **96**. 844.)

$+17H_2O$. (Gawalowski, C. C. **1885**. 721.)

$+18H_2O$. Permanent. (Berzelius.)

Min. *Alunogen.*

$+27H_2O$. Efflorescent. (M.-D., C. R. **99**. 800.)

Aluminum ammonium sulphate (Ammonia alum), $(NH_4)_2Al_2(SO_4)_4+24H_2O$.

100 pts. H_2O dissolve 2·9 pts. anhydrous salt at 0°; 207·7 pts. anhydrous salt at 110·6°. (Mulder.)

100 pts. H_2O dissolve 8·74 pts. anhydrous salt at 17·5°. (Pohl, W. A. B. **6.** 597.)

100 pts. H_2O dissolve (*a*) pts. anhydrous alum, and (*b*) pts. crystallised at t°.

	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
a	2·62	4·50	6·57	9·05	12·35	15·9	21·1	26·95	35·2	50·3	70·83
b	5·22	9·16	13·66	19·29	27·3	36·5	51·3	71·97	103·1	187·8	421·9

(Poggiale, A. ch. (3) **8.** 467.)

B.-pt. of sat. solution is 110·6°.

Insol. in alcohol. (Mulder.)

M.-pt. of $Al_2(NH_4)_2(SO_4)_4+24H_2O=92°$. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of aqueous solution at 15° containing:

3	6	9 % $(NH_4)_2Al_2(SO_4)_4+24H_2O$.
1·0141	1·0282	1·0423

(Gerlach, Z. anal. **28.** 495.)

Min. *Tschermigite.*

Aluminum ammonium chromium sulphate, $(NH_4)_2SO_4$, $Al_2(SO_4)_3$, $(NH_4)_2SO_4$, $Cr_2(SO_4)_3+48H_2O$.

Sol. in H_2O; decomp. by boiling. (Vohl, A. **94.** 71.)

Aluminum cæsium sulphate, $Al_2Cs_2(SO_4)_4+24H_2O$.

100 pts. H_2O at 17° dissolve 0·619 pt. cæsium alum. (Redtenbacher, J. pr. **94.** 442.)

Melts in crystal H_2O at 105-106°. (Tilden, Chem. Soc. **45.** 409.)

Solubility in 100 pts. H_2O at t° (calculated for salt dried at 130°).

t°	Pts. alum	t°	Pts. alum	t°	Pts. alum
0	0·19	25	0·49	65	2·38
10	0·29	35	0·69	80	5·29
17	0·38	50	1·235	...	...

(Setterberg, A. **211.** 104.)

Aluminum calcium sulphate, basic, Al_2O_3, $6CaO$, $3SO_3+32H_2O$.

Min. *Ettringite.* Mostly sol. in H_2O; sol. in HCl+Aq.

Aluminum chromium sulphate, $Al_2Cr_2(SO_4)_6$.

Insol. in H_2O.

$Al_2Cr_2(SO_4)_6$, H_2SO_4. Insol. in H_2O. (Étard, C. R. **86.** 1400.)

Aluminum chromium potassium sulphate, $Al_2(SO_4)_3$, $Cr_2(SO_4)_3$, $2K_2SO_4+48H_2O$.

Sol. in H_2O, but decomp. on boiling. (Vohl.)

Aluminum copper sulphate, $2Al_2O_3$, $9CuO$, $3SO_3+21H_2O$.

Min. *Cyanotrichite.* (Percy, Phil. Mag. (3) **36.** 103.)

Aluminum hydroxylamine sulphate, $Al_2(SO_4)_3$, $(NH_2OH)_2SO_4+24H_2O$.

Sol. in H_2O. (Meyeringh, B. **10.** 1946.)

Aluminum ferrous sulphate, $Al_2(SO_4)_3$, $FeSO_4+24H_2O$.

Sol. in H_2O. (Klauer, A. **14.** 261.)

Min. *Halotrichite.*

$Al_2(SO_4)_3$, $2FeSO_4+27H_2O$. Sol. in H_2O. (Berthier.)

Al_2O_3, $2SO_3$, $6FeSO_4$. Easily sol. in H_2O. (Phillips.)

$Al_2(SO_4)_3$, $2FeSO_4$, H_2SO_4. Insol. in H_2O. (Étard, C. R. **87.** 602.)

Aluminum ferric sulphate, $Al_2(SO_4)_3$, $Fe_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Al_2(SO_4)_3$, $Fe_2(SO_4)_3$, H_2SO_4. As above. (Étard.)

Aluminum ferrous potassium sulphate, $Al_2(SO_4)_3$, $12FeSO_4$, $2K_2SO_4+24H_2O$.

Permanent. Sl. sol. in H_2O. (Dufrenoy.)

Aluminum lead sulphate, $Al_2Pb_2(SO_4)_5+20H_2O$.

Permanent; insol. in H_2O. (G. H. Bailey J. Chem. Soc. Ind. **6.** 415.)

Aluminum lithium sulphate, $Li_2Al_2(SO_4)_4+24H_2O$.

Sol. in 24 pts. cold, and 0·87 pt. hot H_2O. (Kralovansky, Schw. J. **54.** 349.)

Does not exist. (Rammelsberg, J. B. **1847-48.** 394; Arfvedson; Gmelin.)

Aluminum lithium potassium sulphate (?).

Sol. in H_2O, from which it crystallises on cooling. (Joss, J. pr. **1.** 142.)

Aluminum magnesium sulphate, $MgSO_4$, $Al_2(SO_4)_3+22H_2O$.

Min. *Pickeringite.*

$2MgSO_4$, $Al_2(SO_4)_3+22H_2O$. Min. *Picraluminite.*

$3MgSO_4$, $Al_2(SO_4)_3+36H_2O$. Very sol. in H_2O. (Klauer, A. **14.** 264.)

Aluminum magnesium manganous sulphate, $Al_2(SO_4)_3$, $MgSO_4$, $MnSO_4+25H_2O$.

As sol. in H_2O as K alum. (Kane.) Very sol. in H_2O. (Smith, Sill. Am. J. (2) **18.** 379.)

Min. *Bosjemanite.*

Aluminum manganous sulphate, $Al_2(SO_4)_3$, $MnSO_4+25H_2O$.

Sol. in H_2O. (Berzelius.)

$+24H_2O$. Min. *Apjohnite.*

Aluminum manganic sulphate, $2Al_2(SO_4)_3$, $Mn_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

Aluminum nickel sulphate, $Al_2(SO_4)_3$, $2NiSO_4$, H_2SO_4.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Aluminum potassium sulphate, basic, $3(Al_2O_3, SO_3), K_2SO_4 + 6H_2O = K_2SO_4, 3Al_2(SO_4)(OH)_4$.

Min. *Alunite.* Insol. in H_2O. Insol. in conc. HCl+Aq.

Sol. in boiling H_2SO_4 of 1·845 sp. gr., but more easily in a mixture of 12 g. H_2SO_4 and 1·5 g. H_2O, and also in weaker acids, if heated to 210°. (Mitscherlich, J. pr. **81.** 108.)

$+9H_2O$. Min. *Löwigite.* Sl. sol. in boiling HCl+Aq. (Mitscherlich, J. pr. **83.** 455.) Nearly insol. in HCl or conc. HNO_3+Aq, but sol. in a mixture of 1 pt. H_2SO_4 and 1 pt. H_2O. (Debray, Bull. Soc. (2) **7.** 9.)

With varying composition. Precipitates. Insol. in H_2O. Very sl. sol. in cold, gradually in hot acids. (Bley, J. pr. **39.** 17.) Very difficultly sol. in warm conc. HCl+Aq, but easily sol. in KOH+Aq. (Naumann, B. **8.** 1630.)

$Al_2O(SO_4)_2, K_2SO_4$. Sol. in H_2O, but decomp. by heating.

Aluminum potassium sulphate (Potash alum), $KAl(SO_4)_2 + 12H_2O$ or $K_2Al_2(SO_4)_4 = K_2SO_4, Al_2(SO_4)_3 + 24H_2O$.

Sol. in H_2O with absorption of heat.

When 100 pts. H_2O at 10·8° are mixed with 14 pts. alum, the temp. is lowered 1·4°. (Rüdorff, B. **2.** 68.)

Burnt alum is very slowly sol. in H_2O.

100 pts. H_2O at t° dissolve P pts. $K_2Al_2(SO_4)_4 + 24H_2O$.

t°	P	t°	P
12·5	7·6	50·0	46·7
21·25	10·4	62·5	230·0
25·0	22·0	75·0	920·0
37·5	44·1	87·5	1566·6

(Brandes, **1822.**)

(Probably supersat.)

Sol. in 18 pts. cold, and 1·6 pts. boiling H_2O (Fourcroy); in 14·12 pts. cold, and 0·75 pt. boiling H_2O (Bergmann); in 15 pts. cold, and 0·75 pt. boiling H_2O (Dumas); in 11·7 pts. H_2O at 18·75° (Abl).

100 pts. H_2O dissolve 14·79 pts. alum at 15·56°, and 133·33 pts. at 100°. (Ure's Dict.)

$K_2Al_2(SO_4)_4$+Aq sat. at 15° contains 10·939 pts. alum in every 100 pts. H_2O. (Michel and Krafft.)

$K_2Al_2(SO_4)_4$+Aq sat. in cold contains 5·2 % alum (Fourcroy), 6·7 % (Boerhave).

100 pts. H_2O at t° dissolve pts. $K_2Al_2(SO_4)_4$.

t°	Pts. $K_2Al_2(SO_4)_4$	Pts. $K_2Al_2(SO_4)_4 + 24H_2O$
0	2·10	3·90
10	4·99	9·52
20	7·74	15·13
30	10·94	22·01
40	14·88	30·92
50	20·09	44·11
60	26·70	66·65
70	35·11	90·67
80	45·66	134·47
90	58·68	209·31
100	74·53	357·48

(Poggiale, A. ch. (3) **8.** 467.)

100 pts. H_2O dissolve $K_2Al_2(SO_4)_4 + 24H_2O$ corresponding to pts. anhydrous $K_2Al_2(SO_4)_4$.

Temp.	Pts. $K_2Al_2(SO_4)_4$	Temp.	Pts. $K_2Al_2(SO_4)_4$
0	3·0	60	25
5	3·5	70	40
10	4·0	80	71
15	5·0	90	109
20	5·9	92·5	119·5
30	7·9	100	154
40	11·7	110	200
50	17·0	111·9	210·6

(Mulder, Scheik. Verhandel. **1864.** 90.)

100 pts. H_2O at 17° dissolve 13·5 pts. $K_2Al_2(SO_4)_4 + 24H_2O$, or 7·36 pts. $K_2Al_2(SO_4)_4$. (Redtenbacher, J. pr. **94.** 442.)

Forms supersaturated solutions very easily. Supersat. solutions are brought to crystallisation by addition of a crystal of alum or an isomorphous substance, as chrome or iron alum. Other substances as NaCl, etc. have no action. (Thomson, Chem. Soc. **35.** 199.)

Sp. gr. of sat. $K_2Al_2(SO_4)_4$+Aq at 8° = 1·045 (Anthon); at 15° = 1·0488 (Michel and Krafft); at 15° = 1·0456 (Stolba).

Sp. gr. of $K_2Al_2(SO_4)_4$+Aq at 15° containing 5 % $K_2Al_2(SO_4)_4$ = 1·0477. (Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $K_2Al_2(SO_4)_4$+Aq at 15°. a = pts. $K_2Al_2(SO_4)_4 + 24H_2O$ in 100 pts. solution; b = pts. $K_2Al_2(SO_4)_4$ in 100 pts. solution; c = pts. $K_2Al_2(SO_4)_4$ for 100 pts. H_2O.

a	b	c	Sp. gr.
4	2·1792	2·2277	1·0210
8	4·3584	4·5570	1·0420
12	6·5376	6·9950	1·0641
13	7·083	7·622	1·0690

(Gerlach, Z. anal. **27.** 280.)

Saturated solution boils at 111·9°, and contains 210·6 pts. $K_2Al_2(SO_4)_4 + 24H_2O$ to 100 pts. H_2O. (Mulder.)

100 pts. H_2O contain 52 pts. $K_2Al_2(SO_4)_4$, and boils at 104·5°. (Griffiths.) Crust forms at 106·3°, when the solution contains 114·2 pts. $K_2Al_2(SO_4)_4$ to 100 pts. H_2O. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $K_2Al_2(SO_4)_4$+Aq containing pts. $K_2Al_2(SO_4)_4$ to 100 pts. H_2O.

B.-pt.	Pts. $K_2Al_2(SO_4)_4$	B.-pt.	Pts. $K_2Al_2(SO_4)_4$
100·5°	17·0	104·0°	83·9
101·0	30·2	104·5	90·7
101·5	41·8	105·0	97·6
102·0	51·6	105·5	103·9
102·5	60·4	106·0	110·5
103·0	68·7	106·5	116·9
103·5	76·7	106·7	120·55

(Gerlach, Z. anal. **26.** 435.)

M.-pt. of $K_2Al_2(SO_4)_4+24H_2O=84·5°$. (Tilden, Chem. Soc. **45.** 409.)

$K_2Al_2(SO_4)_4+Aq$ sat at 10°, and then sat. with K_2SO_4 at same temp., contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous) .	4·0	0·86	...
K_2SO_4	...	9·16	9·7
		10·02	

(Mulder.)

$K_2Al_2(SO_4)_4+Aq$ sat. at 10°, and then sat. with Na_2SO_4 at 9°, contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous) .	4·0	4·1	...
Na_2SO_4	...	8·8	8·4
		12·9	

(Mulder.)

$K_2Al_2(SO_4)_4+Aq$ sat. at 10°, and then sat. with $MgSO_4$ at 9°, contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous) .	4·0	2·7	...
$MgSO_4$	...	31·2	31·1
		33·9	

(Mulder.)

Insol. in sat. $Al_2(SO_4)_3+Aq$. (Crum, A. **89.** 156.)

Insol. in alcohol of 0·905 sp. gr. or less. (Anthon, J. pr. **14.** 125.)

Min. *Kalinite.*

Aluminum rubidium sulphate, $Al_2Rb_2(SO_4)_4+24H_2O$.

100 pts. H_2O dissolve 2·27 pts. at 17°; very sol. in hot H_2O. (Redtenbacher, J. pr. **94.** 442.)

Melts in crystal H_2O at 99°. (Tilden, Chem. Soc. **45.** 409.)

Solubility in 100 pts. H_2O at t° (calculated for salt dried at 130°).

t°	Pts. alum	t°	Pts. alum	t°	Pts. alum
0	0·71	25	1·85	65	9·63
10	1·09	35	2·67	80	21·60
17	1·42	50	4·98	...	...

(Setterberg, A. **211.** 104.)

Aluminum silver sulphate, $Al_2Ag_2(SO_4)_4+24H_2O$.

Decomp. by H_2O. (Church and Northcote, C. N. **9.** 155.)

Aluminum sodium sulphate, $Al_2Na_2(SO_4)_4+24H_2O$.

Very sl. efflorescent.

Sol. in 2·14 pts. H_2O at 13°, or 100 pts. H_2O dissolve 46·7 pts. soda alum. Sol. in 1 pt. boiling H_2O. (Zellner, Schw. J. **36.** 183.)

100 pts. H_2O dissolve 110 pts. at 15·5°, and form a liquid of 1·296 sp. gr. (Ure.)

100 pts. H_2O dissolve 51 pts. soda alum at 16°. (Augé, C. R. **110.** 1139.)

100 pts. H_2O dissolve 110 pts. soda alum at 0°. (Tilden, Chem. Soc. **45.** 409.)

Insol. in absolute alcohol. (Zellner.)

M.-pt. of $Na_2Al_2(SO_4)_4+24H_2O=61°$. (Tilden, Chem. Soc. **45.** 409.)

Min. *Mendozite.*

Aluminum thallous sulphate, $Tl_2Al_2(SO_4)_4+24H_2O$.

Sol. in H_2O. (Cossa, C. C. **1870.** 470.)

$3Al_2(SO_4)_3$, $Tl_2SO_4+96H_2O$. Sol. in H_2O. (Lamy.)

Aluminum zinc sulphate, $Al_2(SO_4)_3, ZnSO_4+24H_2O$.

Sol. in H_2O. (Kane.)

Aluminum sulphate sodium fluoride.

Decomp. by H_2O. (Weber, Dingl. **263.** 112.)

Ammonium sulphate, $(NH_4)_2SO_4$.

Sol. in H_2O with absorption of heat.

75 pts. $(NH_4)_2SO_4$ mixed with 100 pts. H_2O lower the temperature from 13·2° to 6·8°, that is, 6·4°. (Rüdorff, B. **2.** 68.)

Sol. in 1·31 pts. H_2O at 19°. (Schiff, A. **109.** 326.)

Sol. in 2 pts. H_2O at 18·75°. (Abl.)

Sol. in 2 pts. H_2O at 15·6°, and in 1 pt. boiling H_2O. (Fourcroy.)

100 pts. H_2O at 62·6° dissolve 78 pts. $(NH_4)_2SO_4$. (Wenzel.)

100 pts. H_2O at 15° dissolve 66·739 pts. $(NH_4)_2SO_4$. (Michel and Krafft.)

Sol. in 1·3 pts. cold H_2O. (Vogel, N. Rep. Pharm. **10.** 9.)

Sol. in 1·37 pts. cold H_2O at 10°. (Mulder, J. B. **1866.** 67.)

Sol. in 1·34 pts. H_2O at 16-17°. (v. Hauer, W. A. B. **53,** **2.** 221.)

100 pts. H_2O dissolve at:

0° 10° 20° 30°
71·00 73·65 76·30 78·95 pts. $(NH_4)_2SO_4$,
40° 50° 60° 70°
81·60 84·25 86·90 89·55 pts. $(NH_4)_2SO_4$,
80° 90° 100°
92·20 94·85 97·50 pts. $(NH_4)_2SO_4$.

(Alluard, C. R. **59.** 500.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$
0	70·6	8	72·5	16	74·4
1	70·9	9	72·8	17	74·7
2	71·1	10	73·0	18	74·9
3	71·4	11	73·2	19	75·1
4	71·6	12	73·5	20	75·4
5	71·8	13	73·7	21	75·7
6	72·1	14	74·0	22	75·9
7	72·3	15	74·2	23	76·2

Solubility in 100 pts., etc.—*Continued.*

t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$
24	76·4	53	85·5	82	96·0
25	76·7	54	85·8	83	96·4
26	76·9	55	86·2	84	96·8
27	77·2	56	86·6	85	97·2
28	77·5	57	86·9	86	97·6
29	77·8	58	87·3	87	98·0
30	78·0	59	87·7	88	98·4
31	78·3	60	88·0	89	98·8
32	78·6	61	88·4	90	99·2
33	78·9	62	88·7	91	99·6
34	79·2	63	89·1	92	100·0
35	79·5	64	89·5	93	100·4
36	79·8	65	89·9	94	100·8
37	80·1	66	90·2	95	101·2
38	80·4	67	90·6	96	101·6
39	80·7	68	90·9	97	102·1
40	81·0	69	91·3	98	102·5
41	81·3	70	91·6	99	102·9
42	81·7	71	92·0	100	103·3
43	82·0	72	92·4	101	103·8
44	82·3	73	92·7	102	104·2
45	82·7	74	93·1	103	104·6
46	83·0	75	93·4	104	105·1
47	83·3	76	93·8	105	105·5
48	83·7	77	94·2	106	106·0
49	84·0	78	94·5	107	106·5
50	84·4	79	94·9	108	107·0
51	84·7	80	95·3	108·9	107·5
52	85·1	81	96·6	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864**. 60.)

$(NH_4)_2SO_4$+Aq sat. at 15° has sp. gr. 1·248. (Michel and Krafft, A. ch. (3) **41**. 471.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
1	1·0057	18	1·1035	35	1·2004
2	1·0115	19	1·1092	36	1·2060
3	1·0172	20	1·1149	37	1·2116
4	1·0230	21	1·1207	38	1·2172
5	1·0287	22	1·1265	39	1·2228
6	1·0345	23	1·1323	40	1·2284
7	1·0403	24	1·1381	41	1·2343
8	1·0460	25	1·1439	42	1·2402
9	1·0518	26	1·1496	43	1·2462
10	1·0575	27	1·1554	44	1·2522
11	1·0632	28	1·1612	45	1·2583
12	1·0690	29	1·1670	46	1·2644
13	1·0747	30	1·1724	47	1·2705
14	1·0805	31	1·1780	48	1·2766
15	1·0862	32	1·1836	49	1·2828
16	1·0920	33	1·1892	50	1·2890
17	1·0977	34	1·1948	...	...

(Schiff, calculated by Gerlach, Z. anal. **8**. 280.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
5	1·0292	20	1·1160	31	1·1787
10	1·0581	30	1·1730		

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
3	1·0181	10	1·0600	30	1·1773
6	1·0359	20	1·1190	40	1·2352

(Gerlach, Z. anal. **28**. 493.)

Sp. gr. of sat. solution = 1·248. (Gerlach.)

B.-pt. of sat. solution: crust formed at 106·2°, solution containing 88·2 pts. $(NH_4)_2SO_4$ to 100 pts. H_2O; highest temp. observed, 108·2°. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of $(NH_4)_2SO_4$+Aq containing pts. $(NH_4)_2SO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $(NH_4)_2SO_4$	B.-pt.	Pts. $(NH_4)_2SO_4$
100·5°	7·8	105·0°	71·8
101·0	15·4	105·5	78·7
101·5	22·8	106·0	85·5
102·0	30·1	106·5	92·3
102·5	37·2	107·0	99·1
103·0	44·2	107·5	105·9
103·5	51·1	108·0	112·6
104·0	58·0	108·2	115·3
104·5	64·9	...	...

(Gerlach, Z. anal. **26**. 431.)

Sol. with decomp. in HCl+Aq.

Very easily sol., even in conc. NH_4OH+Aq. (Girard, Bull. Soc. (2) **43**. 522.)

100 pts. H_2O dissolve 46·5 pts. $(NH_4)_2SO_4$ and 26·8 pts. NH_4Cl at 21·5°.

100 pts. $(NH_4)_2SO_4$+K_2SO_4+Aq sat. at 16·17° contain 38·41 pts. of the two salts, of which 5·45 pts. are K_2SO_4, and 32·96 pts. $(NH_4)_2SO_4$. (v. Hauer, J. pr. **28**. 137.)

100 pts. H_2O dissolve 50·6 pts. $(NH_4)_2SO_4$ and 7·2 pts. K_2SO_4 at 11°. (Mulder, J. B. **1866**. 67.)

$(NH_4)_2SO_4$ and K_2SO_4 replace each other in solution, so that by adding one of these salts to a seemingly saturated solution of the other, it is dissolved with pptn. of the other salt (Rüdorff, B. **6**. 485.)

Insol. in absolute
alcohol of 0·872
0·905 sp. gr. (A

Sol. in 217·4 pts. of 66·8 % alcohol (sp. gr. = 0·88) at 24·3°. (Pohl, J. pr. **56.** 219.)

Tolerably sol. in alcohol, the sp. gr. of which is greater than 0·860. Insol. in alcohol of sp. gr. less than 0·850.

Solubility in dil. alcohol.

When $(NH_4)_2SO_4$ is dissolved in dil. alcohol, two layers are formed, the compositions of which are as follows:

Sp. gr.	*Lower layer.* 100 ccm. contain in g. alcohol	water	salt
1·2240	...	71·43	74·16
1·1775	8·85	68·26	59·54
1·1661	10·62	67·70	56·56
1·1655	11·29	67·34	56·30
1·1735	11·42	66·54	59·20

Sp. gr.	*Upper layer.* 100 ccm. contain in g. alcohol	water	salt
0·9530	41·37	48·47	5·45
0·9512	44·20	45·95	4·97
0·9440	44·27	45·61	4·51
0·9098	52·64	36·78	1·56
0·8750	62·61	24·60	0·30
0·8549	67·04	18·36	0·09
0·8308	77·55	5·53	0·00

(Bodländer, Z. phys. Ch. **7.** 3, 8.)

Ammonium hydrogen sulphate, NH_4HSO_4.

Sl. deliquescent. Sol. in 1 pt. cold H_2O. (Link.)

Very sl. sol. in alcohol. (Gerhardt, A. ch. (3) **20.** 255.)

$(NH_4)_3H(SO_4)_2$. Not deliquescent. Sol. in H_2O. (Mitscherlich, Pogg. **39.** 198.)

Ammonium *pyro*sulphate, $(NH_4)_2S_2O_7$.

Decomp. by H_2O. (Schulze.)

Ammonium *octo*sulphate, $(NH_4)_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Ammonium bismuth sulphate, $NH_4Bi(SO_4)_2+4H_2O$.

Easily sol. in HCl, and HNO_3+Aq; less sol. in conc. H_2SO_4, and hot dil. acids. Slowly decomp. by cold $HC_2H_3O_2$, and dil. H_2SO_4+Aq. (Lüddecke, A. **140.** 277.)

Ammonium cadmium sulphate, $(NH_4)_2SO_4$, $CdSO_4+6H_2O$.

Can be recrystallised from a little H_2O. (v. Hauer.)

$3(NH_4)_2SO_4$, $CdSO_4+10H_2O$. (André, C. R. **104.** 987.)

Ammonium calcium sulphate, $(NH_4)_2Ca(SO_4)_2+H_2O$.

Decomp. by H_2O. (Fassbender, B. **11.** 1968.)

Sol. in $(NH_4)_2SO_4$+Aq. (Rose, Pogg. **110.** 292.)

Ammonium calcium potassium sulphate, $NH_4CaK(SO_4)_2+H_2O$.

Decomp. by cold H_2O. (Fassbender, B. **11.** 1968.)

Ammonium cerous sulphate, $(NH_4)_2Ce_2(SO_4)_4+8H_2O$.

More sol. in cold than in hot H_2O. (Czudnowicz).

Ammonium ceric sulphate, $3(NH_4)_2SO_4$, $Ce(SO_4)_2+4H_2O$.

Slightly efflorescent. Easily sol. in H_2O. (Mendelejeff, A. **168.** 50.)

$3(NH_4)_2SO_4$, $2Ce(SO_4)_2+3H_2O$. Sl. sol. in H_2O. (Mendelejeff.)

Ammonium chromium sulphate, $(NH_4)_2SO_4$, $Cr_2(SO_4)_3$.

Not attacked by boiling H_2O or conc. HCl+Aq. Very slowly attacked by boiling KOH+Aq (sp. gr. = 1·3). Insol. in $CrCl_2$+Aq or $SnCl_2$+Aq. (Klobb, Bull. Soc. (3) **9.** 664.)

$+5H_2O$. Is ammonium chromosulphate, which see.

$(NH_4)_2Cr_2(SO_4)_4+24H_2O$. *Violet modification.* Efflorescent. Sol. in cold H_2O, but solution is decomp. on heating with formation of green modification. The dil. solution of green modification is gradually converted into violet modification by standing. Alcohol ppts. it from aqueous solution. (Schrötter, Pogg. **53.** 526.)

Sp. gr. of aqueous solution of violet modification at 15°, containing:

4	8	12 % $(NH_4)_2Cr_2(SO_4)_4+24H_2O$.
1·020	1·0405	1·0610

Sat. solution at 15° has sp. gr. = 1·070. (Gerlach.)

Green modification. Sol. in H_2O and alcohol. When in aqueous solution, it gradually changes to violet modification.

Sp. gr. of aqueous solution of green modification at 15°, containing:

10	20	30 % $(NH_4)_2Cr_2(SO_4)_4+24H_2O$,
1·044	1·091	1·142
40	50	60 % $(NH_4)_2Cr_2(SO_4)_4+24H_2O$,
1·197	1·255	1·317
70	80	90 % $(NH_4)_2Cr_2(SO_4)_4+24H_2O$.
1·384	1·456	1·532

(Gerlach, Z. anal. **28.** 498.)

$3(NH_4)_2SO_4$, $Cr_2(SO_4)_3$. Only sl. attacked by boiling H_2O. Not attacked by boiling conc. $(NH_4)_2SO_4$+Aq. (Klobb, Bull. Soc. (3) **9.** 663.)

Ammonium cobaltous sulphate, $(NH_4)_2Co(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve at:

0°	10°	18°	23°	35°	
8·9	11·6	15·2	17·1	19·6	pts. anhydrous salt,
40°	45°	50°	60°	75°	
22·3	25	28·7	34·5	43·3	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 pts. saturated solution contain at:

20°	40°	60°	80°
14·9	20·8	25·6	33 pts. anhydrous salt.

(v. Hauer, J. pr. **74**. 433.)

Pptd. from aqueous solution by alcohol.

Ammonium cobaltic sulphate, $(NH_4)_2Co_2(SO_4)_4+24H_2O$.

Sol. in H_2O with decomp. (Marshall, Chem. Soc. **59**. 760.)

Ammonium cobaltous cupric sulphate, $2(NH_4)_2SO_4, CoSO_4, CuSO_4+12H_2O$.

Quite easily sol. in hot H_2O, but on long boiling a basic salt is pptd. (Vohl, A. **94**. 58.)

Ammonium cobaltous ferrous sulphate, $2(NH_4)_2SO_4, CoSO_4, FeSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cobaltous magnesium sulphate, $2(NH_4)_2SO_4, CoSO_4, MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cobaltous manganous sulphate, $2(NH_4)_2SO_4, CoSO_4, MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cobaltous nickel sulphate, $2(NH_4)_2SO_4, CoSO_4, NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cobaltous zinc sulphate, $2(NH_4)_2SO_4, CoSO_4, ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cupric sulphate, $(NH_4)_2SO_4, CuSO_4+6H_2O$.

Efflorescent in warm air.

Sol. in 1·5 pts. boiling H_2O, and separates almost wholly on cooling. (Vogel, J. pr. **2**. 194.)

Sol. in 1·55 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O at 19° dissolve 26·6 pts., and sat. solution has sp. gr. = 1·1336. (Schiff, A. **109**. 326.)

$(NH_4)_2SO_4, 2CuSO_4$. Very sol. in H_2O. (Klobb, C. R. **115**. 230.)

Ammonium cupric ferrous sulphate.

Sol. in H_2O without decomposition. (Vohl, A. **94**. 61.)

Ammonium cupric magnesium sulphate, $2(NH_4)_2SO_4, CuSO_4, MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cupric magnesium potassium sulphate, $(NH_4)_2SO_4, CuSO_4, MgSO_4, K_2SO_4+12H_2O$.

Sol. in H_2O. (Schiff.)

$2(NH_4)_2SO_4, CuSO_4, 2MgSO_4, K_2SO_4+18H_2O$. Sol. in H_2O. (Schiff.)

Ammonium cupric manganous sulphate, $2(NH_4)_2SO_4, CuSO_4, MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium cupric nickel sulphate, $2(NH_4)_2SO_4, CuSO_4, NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium cupric potassium sulphate, $NH_4KSO_4, CuSO_4+6H_2O$.

Sol. in H_2O. (Schiff.)

Ammonium cupric zinc sulphate, $2(NH_4)_2SO_4, CuSO_4, ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium cupric sulphate ammonia, $(NH_4)_2SO_4, CuO, 2NH_3$.

Sol. in 1·5 pts. cold H_2O, but decomp. on exposure to air or dilution. Insol. in alcohol. (Kühn.)

Ammonium didymium sulphate, $(NH_4)_2SO_4, Di_2(SO_4)_3+8H_2O$.

Sol. in 18 pts. H_2O, and less easily in $(NH_4)_2SO_4$+Aq. (Marignac.)

Moderately sol. in H_2O. (Cleve, Bull. Soc (2) **43**. 362.)

Ammonium erbium sulphate, $(NH_4)_2SO_4, Er_2(SO_4)_3+8H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium gallium sulphate, $(NH_4)_2Ga_2(SO_4)_4+24H_2O$.

Sol. in cold water and dilute alcohol. Conc. solution clouds up on boiling, but clears on cooling. Dil. solution separates out a basic salt, insol. in hot or cold H_2O. (Boisbaudran.)

Ammonium glucinum sulphate, $(NH_4)_2SO_4, GlSO_4+2H_2O$.

Sol. in H_2O. (Atterberg.)

Ammonium indium sulphate, $(NH_4)_2In_2(SO_4)_4+24H_2O$.

100 pts. H_2O dissolve 200 pts. salt at 16°, and 400 pts. at 30°.

Insol. in alcohol.

Melts in crystal H_2O at 36°. (Rössler, J. pr. (2) **7**. 14.)

$+8H_2O$. (Rössler.)

Ammonium ferrous sulphate, $(NH_4)_2Fe(SO_4)_2+6H_2O$.

Much less sol. in H_2O than $FeSO_4+7H_2O$. (Vogel, J. pr. **2**. 192.)

100 pts. H_2O dissolve at:

0°	12°	20°	30°	36°
12·2	17·5	21·6	28·1	31·8 pts. anhydrous salt,
45°	55°	60°	65°	75°
36·2	40·3	44·6	49·8	56·7 pts. anhydrous salt.

(Tobler, A. **95**. 193.)

100 pts. H_2O at 16·5° dissolve 35·9 pts. hydrous salt.

Sp. gr. of $(NH_4)_2FeSO_4$+Aq at 19°; % = % $(NH_4)_2FeSO_4+6H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·006	11	1·066	21	1·130
2	1·013	12	1·073	22	1·136
3	1·018	13	1·080	23	1·143
4	1·024	14	1·085	24	1·150
5	1·030	15	1·092	25	1·156
6	1·036	16	1·097	26	1·164
7	1·042	17	1·104	27	1·171
8	1·047	18	1·110	28	1·179
9	1·054	19	1·116	29	1·185
10	1·060	20	1·124	30	1·193

(Schiff, calculated by Gerlach, Z. anal. **8**. 280.)

Insol. in acetone.

Ammonium ferric sulphate, basic.

Extremely difficultly sol. in HCl+Aq. Not decomp. by KOH+Aq. (Berzelius.)

$5(NH_4)_2O$, $3Fe_2O_3$, $12SO_3+18H_2O$ or $2(NH_4)_2O$, Fe_2O_3, $4SO_3+4H_2O$. Sol. in 2·4 pts. cold H_2O. (Maus, Pogg. **11**. 79.)

Ammonium ferric sulphate, $(NH_4)_2SO_4$, $Fe_2(SO_4)_3$.

Attacked slowly by cold H_2O. (Lachaud and Lepierre.)

$+24H_2O$. *Iron alum.* Sol. in 3 pts. H_2O at 15°. (Forchhammer, Ann. Phil. **5**. 406.)

Sp. gr. of aqueous solution at 15° containing:

5	10	15 % $(NH_4)_2Fe_2(SO_4)_4+24H_2O$,
1·023	1·047	1·071
20	25	30 % $(NH_4)_2Fe_2(SO_4)_4+24H_2O$,
1·096	1·122	1·148
35	40 % $(NH_4)_2Fe_2(SO_4)_4+24H_2O$.	
1·175	1·203	

40 % solution is sat. at 15°. (Gerlach, Z. anal. **28**. 496.)

$3(NH_4)_2SO_4$, $Fe_2(SO_4)_3$. Insol. in cold H_2O. (Lachaud and Lepierre.)

Ammonium ferroferric sulphate, $4(NH_4)_2SO_4$, $FeSO_4$, $Fe_2(SO_4)_3+3H_2O$.

Sl. sol. in cold H_2O; decomp. into basic salt by hot H_2O; insol. in alcohol. (Lachaud and Lepierre, C. R. **114**. 916.)

Ammonium ferrous magnesium sulphate, $4(NH_4)_2SO_4$, $3FeSO_4$, $MgSO_4+24H_2O$.

Sol. in H_2O. (Schiff, A. **107**. 64.)

$2(NH_4)_2SO_4$, $FeSO_4$, $MgSO_4+12H_2O$. Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium ferrous manganous sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium ferrous nickel sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium ferrous zinc sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Bette, A. **14**. 286.)

Ammonium lanthanum sulphate, $(NH_4)_2SO_4$, $La_2(SO_4)_3+8H_2O$.

Sl. sol. in H_2O. (Marignac.)

Quite sol. in H_2O. (Cleve.)

Ammonium lead sulphate, $(NH_4)_2SO_4$, $PbSO_4$.

Decomp. by H_2O into its constituents. (Wöhler and Litton, A. **43**. 126.)

Ammonium lithium sulphate, NH_4LiSO_4.

Easily sol. in H_2O. (Arfvedson.)

Ammonium magnesium sulphate, $(NH_4)_2Mg(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 15·9 pts. anhydrous double salt at 13°. (Mulder.)

100 pts. H_2O dissolve at:

0°	10°	15°	20°	30°	
9·0	14·2	15·7	17·9	19·1	pts. anhydrous salt,
45°	50°	55°	60°	75°	
25·6	30·0	31·9	36·1	45·3	pts. anhydrous salt.

(Tobler, A. **96**. 193.)

More sol. in H_2O than $(NH_4)_2SO_4$ or $MgSO_4$. (Graham.)

Min. *Cerbolite.*

Ammonium magnesium nickel sulphate, $2(NH_4)_2SO_4$, $MgSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium magnesium potassium zinc sulphate, $2(NH_4)_2SO_4$, $3MgSO_4$, $3K_2SO_4$, $2ZnSO_4+30H_2O$.

Sol. in H_2O. (Schiff, A. **107**. 64.)

$(NH_4)_2SO_4$, $2MgSO_4$, $2K_2SO_4$, $ZnSO_4+18H_2O$. Sol. in H_2O. (Schiff.)

$(NH_4)_2SO_4$, $MgSO_4$, K_2SO_4, $ZnSO_4+12H_2O$. Sol. in H_2O. (Schiff.)

Ammonium magnesium zinc sulphate, $2(NH_4)_2SO_4$, $MgSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium manganous sulphate, $(NH_4)_2SO_4$, $MnSO_4+6H_2O$.

Deliquescent. Easily sol. in H_2O. (Jahn.)

Ammonium manganic sulphate, $(NH_4)_2Mn_2(SO_4)_4+24H_2O$.

Decomp. by H_2O. (Mitscherlich.)

Ammonium manganous nickel sulphate, $2(NH_4)_2SO_4$, $MnSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium manganous zinc sulphate, $2(NH_4)_2SO_4$, $MnSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium mercuric sulphate, $(NH_4)_2SO_4$, $3HgSO_4+2H_2O$.

(Hirzel, J. B. **1850**. 333.)

$(NH_4)_2SO_4$, $HgSO_4$. Difficultly sol. in H_2O. Easily sol. in NH_4OH+Aq.

Ammonium nickel sulphate, $(NH_4)_2SO_4$, $NiSO_4+6H_2O$.

Sol. in 4 pts. cold H_2O. (Link, **1796**.)

100 pts. H_2O dissolve at:

3·5°	10°	16°	20°	30°	
1·8	3·2	5·8	5·9	8·3	pts. anhydrous salt,
40°	50°	59°	68°	85°	
11·5	14·4	16·7	18·8	28·6	pts. anhydrous salt.

(Tobler, A. **95**. 193.)

100 pts. sat. solution contain at 20°, 9·4; at 40°, 13·2; at 60°, 18·6; at 80°, 23·1 pts. anhydrous salt. (v. Hauer, J. pr. **74**. 433.)

Nearly insol. in a weak acid solution of $(NH_4)_2SO_4$. (Thompson, C. C. **1863**. 957.)

Ammonium nickel zinc sulphate, $2(NH_4)_2SO_4$, $NiSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ammonium nickel sulphate ammonia, $(NH_4)_2SO_4$, $NiSO_4$, $6NH_3+3H_2O$.

(André, C. R. **106**. 936.)

Ammonium platinic sulphate, $2(NH_4)_2SO_4$, $Pt_3(SO_4)_3+25H_2O$.

Sol. in H_2O. (Prost, Bull. Soc. (2) **46**. 156.)

Ammonium potassium sulphate, $(NH_4)_2SO_4$, $K_2SO_4+4H_2O$.

Soluble in H_2O. 100 pts. H_2O at 16° dissolve 13·68 pts. salt. (Thomson, **1831**.)

Min. *Taylorite.*

Ammonium samarium sulphate, $(NH_4)_2SO_4$, $Sm_2(SO_4)_3+8H_2O$.

Sl. sol. in H_2O. (Cleve, Bull. Soc. (2) **43**. 166.)

Ammonium scandium sulphate, $(NH_4)_2SO_4$, $Sc_2(SO_4)_3$.

Sol. in H_2O. (Cleve.)

Ammonium sodium sulphate, $NH_4NaSO_4+2H_2O$.

100 pts. H_2O dissolve 46·6 pts. of cryst. salt at 15°, and the solution has a sp. gr. of 1·1749.

Sp. gr. of aqueous solution containing:

31·8	25·44	15·9 % $NH_4NaSO_4+2H_2O$,
1·1749	1·1380	1·0849

12·72	6·36 % $NH_4NaSO_4+2H_2O$.
1·0679	1·0337

(Schiff, A. **114**. 68.)

Ammonium strontium sulphate.

Insol. in excess of $(NH_4)_2SO_4$+Aq. (Rose, Pogg. **110**. 296.)

Ammonium thorium sulphate, $2(NH_4)_2SO_4$, $Th(SO_4)_2$.

Easily sol. in H_2O and sat. $(NH_4)_2SO_4$+Aq. (Cleve.)

Ammonium uranous sulphate, $2(NH_4)_2SO_4$, $U(SO_4)_2$.

Easily sol. in H_2O. (Rammelsberg.)

Ammonium uranyl sulphate, $(NH_4)_2SO_4$, $(UO_2)SO_4+2H_2O$.

Quite difficultly sol. in H_2O. (Arfvedson.)

Ammonium yttrium sulphate, $2(NH_4)_2SO_4$, $Y_2(SO_4)_3+9H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium zinc sulphate, $(NH_4)_2SO_4$, $ZnSO_4+6H_2O$.

100 pts. H_2O dissolve pts. $(NH_4)_2SO_4$, $ZnSO_4$ at:

0°	10°	13°	15°	20°
7·3	8·8	10·0	12·5	12·6 pts. salt,

30°	45°	60°	75°	85°
16·5	21·7	29·7	37·8	46·2 pts. salt.

(Tobler, A. **95**. 193.)

+$7H_2O$. (André, C. R. **104**. 987.)

Ammonium zirconium sulphate.

Sol. in cold or hot H_2O or in acids. (Berzelius.)

Ammonium sulphate antimony fluoride.

See **Antimony fluoride ammonium sulphate.**

Antimony sulphate, basic, $7Sb_2O_3$, $2SO_3+3H_2O$.

Insol. in, and not decomp. by hot or cold H_2O. (Adie, Chem. Soc. **57**. 540.)

$5Sb_2O_3$, $2SO_3+7H_2O$. Insol. in H_2O. (Hensgen, R. t. c. **4**. 401.)

$2Sb_2O_3$, SO_3+xH_2O. Not decomp. by cold H_2O. (Adie.)

Sb_2O_3, $SO_3=(SbO)_2SO_4$. Decomp. by hot H_2O. (Peligot, J. B. **1847**. 426.)

+H_2O. As above. (Adie.)

Sb_2O_3, $2SO_3$, and $+H_2O$, and $+2H_2O$. Scarcely decomp. by cold, slowly by boiling H_2O. Slowly sol. in dil. HCl+Aq. (Adie.)

Antimony sulphate, $Sb_2(SO_4)_3$.

Very deliquescent. Combines with H_2O to a hard mass with evolution of heat; with more H_2O it becomes liquid, and by repeated treatment with much boiling H_2O it is wholly decomp. into H_2SO_4 and Sb_2O_3. (Hensgen, R. t. c. **4**. 401.)

Antimony sulphate, acid, Sb_2O_3, $4SO_3$,

Decomp. by H_2O. (Adie.)

Sb_2O_3, +8 or $9SO_3$. Decomp. by H_2O. (Adie.)

Arsenic sulphate.

See **Arsenic sulphur** *tri***oxide.**

Barium sulphate, $BaSO_4$.

Sol. in 43,000 pts. H_2O (Kirwan); in 200,000 pts. H_2O (Margueritte, C. R. **38**. 308).

100 pts. H_2O dissolve 0·002 pt. $BaSO_4$. (Ure's Dict.)

$BaCl_2$+Aq containing 1 pt. BaO to 71,000 pts. H_2O, when treated with H_2SO_4, becomes turbid in ½ hour. (Harting, J. pr. **22**. 52.)

$Ba(NO_3)_2$+Aq containing 1 pt. BaO to 25,000 pts. H_2O gives a distinct cloud with H_2SO_4 or Na_2SO_4+Aq; with 50,000-100,000 pts. H_2O a slight turbidity is produced; with 200,000-400,000 pts. H_2O the mixture becomes turbid in a few minutes; while with 800,000 pts. H_2O no action is visible. (Lassaigne, J. Chim. Méd. **8**. 526.)

Sol. in 800,000 pts. H_2O (Calvert); in 400,000 pts. cold or hot H_2O (Fresenius).

Calculated from the electrical conductivity of the solution, $BaSO_4$ is sol. in 429,700 pts. H_2O at 18·4°, and 320,000 pts. at 37·7°. (Holleman, Z. phys. Ch. **12**. 131.)

1 l. H_2O dissolves 1·72 mg. at 2°; 1·97 mg. at 10°; 2·29 mg. at 19·0°; 2·60 mg. at 26°; 2·91 mg. at 34°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Not attacked by cold HCl or HNO_3+Aq after several hours, and only in traces after several days. On boiling, traces of $BaSO_4$ dissolve, and the liquid after cooling can be precipitated by $BaCl_2$ or H_2SO_4+Aq, but not by H_2O alone. (Rose, Pogg. **95**. 108.)

By washing $BaSO_4$ long enough with H_2O containing HCl or HNO_3 [$HC_2H_3O_2$ (Siegle)], the filtrate can be precipitated by H_2SO_4 or $BaCl_2$. (Piria, J. B. **1856**. 334.)

100,000 pts. H_2O dissolve 0·124 pt. $BaSO_4$; 1000 pts. HNO_3+Aq of 1·167 sp. gr. dissolve 2 pts. $BaSO_4$; 1000 pts. HNO_3+Aq of 1·032 sp. gr. dissolve 0·062 pt. $BaSO_4$. (Calvert, Chem. Gaz. **1856**. 55.)

1000 pts. 3 % HCl+Aq dissolve 0·06 pt. $BaSO_4$ in the cold, and still more on boiling.

230 ccm. HCl+Aq of 1·02 sp. gr. dissolve 0·048 g. $BaSO_4$ from 0·679 g. of $BaSO_4$ when boiled ½ hour.

168 ccm. HCl+Aq of 1·03 sp. gr. dissolve 0·0075 g. $BaSO_4$ from 0·577 g. $BaSO_4$ when boiled 5 minutes.

When 0·4 g. $BaSO_4$ is heated ¼ hour with 150 ccm. HNO_3+Aq of 1·02 sp. gr., 0·165 g. is dissolved.

Acetic acid has the least solvent power; 80 ccm. $HC_2H_3O_2$+Aq of 1·02 sp. gr. boiled with 0·4 g. $BaSO_4$ ¼ hour dissolve 0·002 g. (Siegle, J. pr. **69.** 142.)

Sol. in boiling conc. H_2SO_4. (See $BaH_2(SO_4)_2$).

Sol. in fuming H_2SO_4. (See BaS_2O_7.)

Sol. in 2500 pts. boiling 40 % HBr+Aq; in 6000 pts. boiling 40 % HI+Aq. (Haslam, C. N. **53.** 87.)

Not attacked by boiling conc. KOH+Aq if CO_2 is not present. (Rose, Pogg. **95.** 104.)

Very sl. decomp. by standing a long time with cold conc. alkali carbonates +Aq.

Decomp. by boiling Na_2CO_3 or K_2CO_3+Aq, not by $(NH_4)_2CO_3$+Aq. (See Storer's Dict. for analytical data.)

Very sl. sol. in NH_4Cl+Aq, 1 pt. dissolving in 230,000 pts. sat. NH_4Cl+Aq.

500 ccm. sat. NH_4NO_3+Aq with 50 ccm. sat. NH_4Cl+Aq dissolve 2 g. $BaSO_4$. 100 ccm. sat. NH_4NO_3+Aq with 100 ccm. sat. NH_4Cl+Aq dissolve only 0·08 g. $BaSO_4$, therefore above solubility is due to free chlorine. (Mittentzwey, J. pr. **75.** 214.)

$BaSO_4$ cannot be precipitated from solution containing free Cl_2. (Erdmann, J. pr. **75.** 215.)

Pptn. retarded sl. by tartaric and racemic acids. (Spiller.)

Na metaphosphate prevents pptn. of $BaSO_4$, but not ortho- or pyrophosphate. (Scheerer, J. pr. **75.** 114.)

Not precipitated in presence of alkali citrates. (Spiller.)

Sol. in considerable amount in metaphosphoric acid +Aq. (Scheerer and Drechsel, J. pr. (2) **7.** 68.)

Much less sol. in NH_4Cl+Aq than in NH_4NO_3+Aq. Insol. in warm conc. $Na_2S_2O_3$+Aq. (Diehl, J. pr. **79.** 431.)

Not appreciably sol. in H_2O containing ammonium or sodium chloride. (Brett, Wittstein, Wackenroder.)

Not appreciably sol. in H_2O at 250°, or in H_2O containing Na_2S. (Senarmont.)

Solubility is increased by alkali nitrates, but not appreciably by NaCl, $KClO_3$, or $Ba(NO_3)_2$. (Fresenius, Z. anal. **9.** 52.) Scarcely sol. in boiling conc. $(NH_4)_2SO_4$+Aq. (Fresenius.)

Solubility in H_2O increased by presence of $MgCl_2$ (Fresenius); cerium salts (Marignac).

Sol. in Fe_2Cl_6+Aq. (Lunge, Z. anal. **19.** 141.)

Min. *Barite.*

Barium hydrogen sulphate, $BaH_2(SO_4)_2$.

100 pts. H_2SO_4 dissolve 2·22 pts. $BaSO_4$ (Lies-Bodart and Jacquemin, C. R. **46.** 1206); dissolve 5·69 pts. $BaSO_4$ (Struve, Z. anal. **9.** 34).

Boiling H_2SO_4 dissolves 10-12 % freshly precipitated $BaSO_4$ without separating crystals on cooling. H_2SO_4 at 100° dissolves more than boiling H_2SO_4, and becomes cloudy if heated to boiling. (Schultz, Pogg. **133.** 146.)

1 g. $BaSO_4$ pptd. from $BaCl_2$ is sol. in 3153 g. 91 % H_2SO_4; from $Ba(NO_3)_2$ is sol. in 1519 g. 91 % H_2SO_4. (Varenne and Pauleau, C. R. **93.** 1016.)

Decomp. by H_2O, alcohol, or ether.

$+2H_2O$. (Schultz.)

Barium *pyro*sulphate, BaS_2O_7.

100 pts. fuming H_2SO_4 dissolve 15·89 pts. $BaSO_4$. (Struve, Z. anal. **9.** 34.)

Very deliquescent.

Decomp. with H_2O with hissing. (Schultz-Sellack, B. **4.** 111.)

Barium calcium sulphate, $3BaSO_4$, $CaSO_4$.

Min. *Dreelite.*

Barium platinic sulphate (?).

Insol. in H_2O or boiling HCl or HNO_3+Aq. Sol. in hot conc. H_2SO_4 or aqua regia. (E. Davy.)

Bismuth sulphate, basic, $(BiO)_2SO_4$.

Insol. in H_2O. Sol. in HNO_3 or H_2SO_4+Aq.

$+2H_2O$. (Heintz, Pogg. **63.** 55.)

$4Bi_2O_3$, $3SO_3+15H_2O$. Insol. in H_2O. (Leist.)

$(BiO)HSO_4+H_2O$. Insol. in H_2O. Sol. in dil. H_2SO_4+Aq.

$+2H_2O$. Decomp. by H_2O with separation of $(BiO)_2SO_4+2H_2O$. (Heintz.)

$3Bi_2O_3$, $2SO_3+2H_2O$. Insol. in H_2O. (Athanasesco, C. R. **103.** 271.)

Bismuth sulphate, $Bi_2(SO_4)_3$.

Very hygroscopic. Takes up H_2O with strong evolution of heat to form $2Bi_2(SO_4)_3+7H_2O$, which becomes $Bi_2(SO_4)_3+3H_2O$ at 100°. Decomp. by boiling H_2O into Bi_2O_3, SO_3+H_2O. (Hensgen, J. B. **1885.** 552.)

Bismuth sulphate, acid, Bi_2O_3, $4SO_3+7$, or $9H_2O=BiH(SO_4)_2+3H_2O$.

Insol. in H_2O. Easily sol. in acids, especially HCl, and HNO_3+Aq. (Leist, A. **160.** 29.)

Bismuth potassium sulphate, $Bi_2(SO_4)_3$, $3K_2SO_4$ (?).

Decomp. by H_2O; insol. in sat. K_2SO_4+Aq. (Heintz.)

$Bi_2(SO_4)_3$, $2K_2SO_4$.

$BiK(SO_4)_2=Bi_2(SO_4)_3$, K_2SO_4. Insol. in cold H_2O; decomp. by boiling. (Brigham, Am. Ch. J. **14.** 170.)

Bismuth sodium sulphate, $Bi_4Na_6(SO_4)_9$.

(Lüdecke, A. **140.** 277.)

Boron sulphate.

See **Borosulphuric acid.**

Bromomolybdenum sulphate.

See under **Bromomolybdenum compounds.**

Cadmium sulphate, basic, $2CdO$, SO_3, and $+H_2O$.

Difficultly sol. in H_2O. (Stromeyer.) Sl. sol. in hot H_2O. (Habermann, M. **5.** 432.)

Cadmium sulphate, $CdSO_4$.

$+H_2O$. (v. Hauer.)

$+2\frac{2}{3}H_2O$. 1 pt. H_2O dissolves 0·59 pt. anhydrous salt at 23°, and not much more on heating. Sat. solution boils at 102°. Precipitated by alcohol. (v. Hauer.)

If solubility S=pts. anhydrous $CdSO_4$ in 100 pts. of solution—

$S=35{\cdot}7+0{\cdot}2166t$ from 0° to 68° when the line breaks, and—

$S=50{\cdot}6-0{\cdot}3681t$ from 68° to 200°. Insol. in H_2O at 215°. (Étard, C. R. **106.** 741.)

Cadmium cæsium sulphate, $CdSO_4$, $Cs_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

Cadmium cerium sulphate, $CdSO_4$, $Ce_2(SO_4)_3+6H_2O$.

Sol. in H_2O. (Wyrouboff.)

Cadmium magnesium sulphate, $CdSO_4$, $MgSO_4+14H_2O$.

Very efflorescent. Sol. in H_2O. (Schiff, A. **104.** 325.)

Cadmium potassium sulphate, K_2SO_4, $CdSO_4+1\frac{1}{2}H_2O$.

Sol. in H_2O. (v. Hauer, Pogg. **133.** 176.)

$+2H_2O$. Slowly efflorescent. (v. Hauer.)

$+6H_2O$. Very efflorescent, and easily decomp. (Schiff.)

Cadmium rubidium sulphate, $CdSO_4$, $Rb_2SO_4+6H_2O$.

Efflorescent. Sol. in H_2O. (Tutton.)

Cadmium sodium sulphate, $CdSO_4$, $Na_2SO_4+2H_2O$.

Sol. in H_2O. (v. Hauer.)

Cadmium sulphate ammonia, $CdSO_4$, $6NH_3$.

Sol. in H_2O with separation of CdO. (Rose, Pogg. **20.** 152.)

$CdSO_4$, $4NH_3+4H_2O$. Decomp. by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)

$+2H_2O$. Ppt. (André, C. R. **104.** 987.)

$+2\frac{1}{2}H_2O$. Sol. in H_2O with separation of basic sulphate. (Müller, A. **149.** 70.)

Cæsium sulphate, Cs_2SO_4.

Not deliquescent.

100 pts. H_2O dissolve 158·7 pts. Cs_2SO_4 at −2°.

Insol. in alcohol. (Bunsen.)

Cæsium hydrogen sulphate, $CsHSO_4$.

Sol. in H_2O.

Cæsium ***pyro*****sulphate,** $Cs_2S_2O_7$.

Decomp. by H_2O.

Cæsium ***octo*****sulphate,** $Cs_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Cæsium cobaltous sulphate, Cs_2SO_4, $CoSO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

Cæsium copper sulphate, Cs_2SO_4, $CuSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cæsium ferrous sulphate, Cs_2SO_4, $FeSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cæsium magnesium sulphate, Cs_2SO_4, $MgSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cæsium manganous sulphate, Cs_2SO_4, $MnSO_4+8H_2O$.

Sol. in H_2O. (Tutton.)

Cæsium nickel sulphate, Cs_2SO_4, $NiSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cæsium zinc sulphate, Cs_2SO_4, $ZnSO_4+6H_2O$.

Sol. in H_2O. (Bunsen and Kopp, Pogg. **113.** 337.)

Calcium sulphate, $CaSO_4$, and $+2H_2O$.

The older determinations of the solubility of $CaSO_4$ in H_2O have little, but historical, value, as the solutions were usually either non-saturated or supersaturated. They may be tabulated as follows.

A=pts. H_2O required for dissolving 1 pt. $CaSO_4$, and B for 1 pt. $CaSO_4+2H_2O$ at t°.

t°	A	B	Authority
Hot or cold	500	...	Fourcroy
Cold	500	...	Bergmann
Boiling	450	...	,,
All temp.	322	...	Lassaigne
(?)	438	...	Anthon
(?)	250-300	...	Dumas
Hot or cold	578·5	461·5	Bucholz
Cold	481	380	Giese
Hot	491	388	,,
15-20°	492	388	Tipp
12·5°	503	397	Lecoq

100 pts. H_2O at t° dissolve pts. $CaSO_4$.

t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$
0	0·205	35	0·254	70	0·244
5	0·219	40	0·252	80	0·239
12	0·233	50	0·251	90	0·231
20	0·241	60	0·248	100	0·217
30	0·249	...	...	...	...

(Poggiale, A. ch. (3) **8.** 469.)

Poggiale worked with supersat. solutions. (Droeze, B. **10.** 330.)

H_2O dissolves $CaSO_4$ most abundantly at 35° (Poggiale); at 32-41° (Marignac).

1 pt. $CaSO_4+2H_2O$ dissolves at:

0°	18°	24°	32°	38°
in 415	386	378	371	368 pts. H_2O,
41°	53°	72°	86°	99°
in 370	375	391	417	451 pts. H_2O,

or (by calculation) 1 pt. anhydrous $CaSO_4$ dissolves at:

0°	18°	24°	32°	38°
in 525	488	479	470	466 pts. H_2O,
41°	53°	72°	86°	99°
in 468	474	495	528	571 pts. H_2O.

These above nonsat. solutions are obtained by using a large excess of $CaSO_4+2H_2O$. The undissolved part retains its water of crystallisation. $CaSO_4$, dehydrated at 130-140°, forms a supersaturated solution with H_2O in 10 minutes containing 1 pt. $CaSO_4$ to 1·10 pts. H_2O, which soon deposits crystals. The undissolved part takes up its water of crystallisation. Ignited $CaSO_4$ dissolves very slowly in H_2O, so that in 24 hours the solution contains $\frac{1}{538}$ to $\frac{1}{598}$ anhydrous $CaSO_4$. By longer contact solution continues with formation of supersaturated solutions, which contain after 10-30 days $\frac{1}{372}$ to $\frac{1}{323}$ $CaSO_4$, but these become normal as the anhydrous $CaSO_4$ gradually takes up its water of crystallisation. The mineral anhydrite behaves similarly, water taking up $\frac{1}{582}$ $CaSO_4$ in 1 day, $\frac{1}{351}$ in 40 days, and $\frac{1}{457}$ in 8 months.

Supersaturated solutions are also obtained by evaporation of a saturated solution. By evaporation with heat, solutions are obtained containing $\frac{1}{308}$ $CaSO_4$, and in the cold with $\frac{1}{182}$ $CaSO_4$, in the solution over the separated $CaSO_4+2H_2O$. Neutralising dil. H_2SO_4+Aq with $CaCO_3$ gives a solution containing $\frac{1}{114}$ $CaSO_4$, which crystallises out partly in 24 hours, leaving $\frac{1}{313}$ $CaSO_4$ dissolved.

Supersaturated solutions containing $\frac{1}{110}$ to $\frac{1}{150}$ $CaSO_4$ deposit crystals rapidly; those under $\frac{1}{350}$ do not crystallise spontaneously. A solution containing $\frac{1}{283}$ shows crystals in 14 days, and contains $\frac{1}{312}$ in 1 month, $\frac{1}{414}$ in 2 months, $\frac{1}{446}$ in 3 months, in spite of repeated shaking.

Boiling diminishes the supersaturation without however removing it entirely. (Marignac, A. ch. (5) **1**. 274.)

1 pt. $CaSO_4+2H_2O$ is sol. in 443 pts. H_2O at 13·7°; in 447 pts. H_2O at 14·2°; in 421 pts. H_2O at 20·2°; in 419 pts. H_2O at 21·2°; and in 445 pts. H_2CO_3+Aq sat. at 18·7°. (Church, J. B. **1867**. 192.)

Church's solutions were not sat. (Droeze, B. **10**. 330.)

1000 pts. H_2O dissolve 2·19 pts. $CaSO_4+2H_2O$ at 16·5°; 2·352 pts. $CaSO_4+2H_2O$ at 22°. (Cossa, Gazz. ch. it. **1873**. 135.)

Cossa's solutions were not saturated. (Droeze.)

$CaSO_4+2H_2O$ is sol. in 415 pts. H_2O at 0°; in 412 pts. H_2O at 5°; in 407 pts. H_2O at 10°; in 398 pts. H_2O at 15°; in 371 pts. H_2O at 20°; in 365 pts. H_2O at 25°; in 361 pts. H_2O at 30°; in 359 pts. H_2O at 35°. (Droeze, B. **10**. 330.)

Sol. in 500 pts. H_2O at 12·5°. (From Marignac's and his own results, de Boisbaudran, A. ch. (5) **3**. 477.)

$CaSO_4$ is sol. in 564·5 pts. H_2O at 0·8°; 506·27 pts. at 14°; 472·3 pts. at 32·5-38·8°; 498·73 pts. at 64°; 533·92 pts. at 79·6°. (Raupenstrauch, M. **6**. 563.)

According to Goldammer (C. C. **1888**. 708) H_2O is fully saturated with $CaSO_4$ by shaking the finely-powdered substance 5 minutes therewith.

The following results were obtained. Figures denote pts. H_2O in which 1 pt. $CaSO_4$ was dissolved at t° (a) from pptd. $CaSO_4$ "ipse fact.," (b) from pptd. $CaSO_4$ "gehe," (c) from "glacies mariae pulv.," (d) from "glacies mariae pulv.," containing less than $2H_2O$.

t°	a	b	c	t°	d
0	561·5	558	557·5	0	476·5
7·5	526	526	520	...	...
15	497·5	497·5	493	20	436
22·5	481	481·5	479	...	...
30	475	475	470	...	...
37·5	463	469	465·5	40	450
45	473·5	474·5	470·5	...	...
60	484	486·5	482	60	476
75	507·5	508	503	80	502·5
90	533·5	530	534	...	...
100	556	557	534·5	100	547

Burnt gypsum easily forms supersat. solutions containing nearly 1 % CaSO. It forms supersat. solutions more readily at 0°, and that tendency decreases with increase of temp., hence figures in (d) which contained burnt gypsum. (Goldammer, C. C. **1888**. 708.)

Calculated from electrical conductivity of $CaSO_4+Aq$, 1 l. H_2O dissolves 2·07 g. $CaSO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Solubility of $CaSO_4$ in 100 pts. H_2O at high temp.

t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$
140	0·078	175-185	0·027	250	0·016
165	0·056	240	0·018	...	...

(Tilden and Shenstone, Phil. Trans. **1884**. 31.)

Solubility of $CaSO_4$ in H_2O at various pressures.

100 g. sat. $CaSO_4+Aq$ at 1 atmos. pressure and 15° contain 0·206 g. $CaSO_4$; at 20 atmos. pressure and 15° contain 0·227 g. $CaSO_4$; at 1 atmos. pressure and 16·2° contain 0·213 g. $CaSO_4$. (Möller, Pogg. **117**. 386.)

$CaSO_4$ is completely insol. in sea water or pure H_2O at temperatures between 140° and 150°. (Cousté.)

Solubility of $CaSO_4$ in sea water at temperatures over 100°. t° = temp.; P = pressure in atmospheres; % = per cent $CaSO_4$ in sat. solution.

t°	P	%	t°	P	%
103	1	0·500	118·5	1·50	0·226
103·8	1	0·477	121·2	1·5	0·183
105·15	1	0·432	124	2	0·140
108·6	1·25	0·395	127·9	2	0·097
111	1·25	0·355	130	2·5	0·060
113·2	1·25	0·310	133·3	2·5	0·023
115·8	1·50	0·267	...	...	...

(Cousté, Ann. Min. (5) **5**. 80.)

Pptn. of $CaSO_4$ which has been started by heating solution to 140-150° continues even after solution has cooled. (Storer.)

Sp. gr. of sat. $CaSO_4+Aq$ at 15° = 1·0022. (Stolba, J. pr. **97**. 503.)

Sl. sol. in cold $HCl+Aq$; completely sol. in boiling dil. HCl or HNO_3+Aq. (Rose, Pogg. **95**. 108.)

Solubility of $CaSO_4$ in $HCl+Aq$.

t°	% HCl	100 ccm. dissolve g. of $CaSO_4$	t°	% HCl	100 ccm. dissolve g. of $CaSO_4$
25	0·77	0·6405	25	6·12	1·6539
25	1·56	0·8821	101	0·77	1·1209
25	3·06	1·2639	102	3·06	3·1780
25	4·70	1·5342	103	6·12	4·6902

(Lunge, J. Soc. Chem. Ind. **4**. 31.)

For solubility in H_2SO_4 see $CaH_2(SO_4)_2$.

1 pt. $CaSO_4$ is sol. in 218 pts. H_2O containing CO_2. (Beyer, Arch. Pharm. (2) **150**. 193.)

Solubility in H_2O is increased by presence of NH_4Cl (Vogel, J. pr. **1**. 196), ammonium succinate (Wittstein, Repert. **57**. 18), $(NH_4)_2SO_4$, $(NH_4)_2B_4O_7$ (Popp, A. Suppl. **8**. 11); also KNO_3 (Vogel, Jun.), Na_2SO_4 (Henry, J. Pharm. **12**. 31), NaCl (Trommsdorf, N. J. Pharm. **18**, **1**. 234).

More than 10 times as much $CaSO_4$ dissolves in sat. $Na_2S_2O_3+Aq$ as in H_2O. (Diehl.)

Sol. to considerable extent in $NH_4C_2H_3O_2+Aq$, especially if freshly pptd. More sol. in $NH_4C_2H_3O_2+Aq$ than in NH_4Cl+Aq. (Weppen, J. pr. **11**. 182.)

Sl. sol. in $MgSO_4+Aq$. (Bergmann.)

More sol. in $NH_4C_2H_3O_2+Aq$ than in other NH_4 salts. (Cohn, J. pr. (2) **35**. 43.)

More sol. in Fe_2Cl_6, Cr_2Cl_6, $CuCl_2$, $ZnCl_2+Aq$ than in H_2O, but not more sol. in $CaCl_2+Aq$. (Gladstone.)

More sol. in $NaC_2H_3O_2+Aq$ or $KCl+Aq$ than in H_2O. (Mulder.)

Decomp. by alkali carbonates $+Aq$. (*See* Storer's Dict.)

1 g. $CaSO_4$ is sol. in 162 ccm. sat. $KCl+Aq$ at 8°; in 147 ccm. sat. $NaCl+Aq$ at 8·5°; in 93 ccm. sat. NH_4Cl+Aq at 12·5°; in 94 ccm. sat. KNO_3+Aq; in 92 ccm. sat. $NaNO_3+Aq$; in 320 ccm. sat. NH_4NO_3+Aq; in 54 ccm. $\frac{2}{5}$ sat. NH_4NO_3+Aq; in about 2000 ccm. sat. K_2SO_4+Aq. (Droeze.)

Solubility in sat. $(NH_4)_2SO_4$, or Na_2SO_4 is the same as in H_2O. (Droeze, B. **10**. 330.)

NH_4Cl+Aq.

1 g. $CaSO_4$ is sol. in 92 ccm. sat. NH_4Cl+Aq at 13·5°; in 94 ccm. $\frac{1}{2}$ sat. NH_4Cl+Aq at 13·5-15·5°; in 200 ccm. $\frac{1}{8}$ sat. NH_4Cl+Aq at 13·5°; in 183 ccm. $\frac{1}{8}$ sat. NH_4Cl+Aq at 100°. (Fassbender, B. **9**. 1360.)

Solubility of $CaSO_4$ in 25% NH_4Cl+Aq.

t°	% $CaSO_4$	t°	% $CaSO_4$
8	1·030	60	1·333
9	1·023	80	1·026
25	1·096	120	1·000
39	1·126	...	...

(Tilden and Shenstone, Roy. Soc. Proc. **38**. 335.)

Solubility of $CaSO_4$ in $CaCl_2+Aq$ at t°.

t°	% $CaCl_2$	100 ccm. dissolve g. of $CaSO_4$	t°	% $CaCl_2$	100 ccm. dissolve g. of $CaSO_4$
23	3·54	0·1225	25	16·91	0·0702
24	6·94	0·0963	101·0	3·54	0·1370
25	10·36	0·0886	102·5	10·36	0·1426
25	15·90	0·0734	103·5	16·91	0·1301

(Lunge, *l.c.*)

Solubility of $CaSO_4$ in H_2O containing various amts. of $CaCl_2$ at 20°. 100 pts. H_2O containing pts. $CaCl_2$ dissolve pts. $CaSO_4$.

Pts. $CaCl_2$	Pts. $CaSO_4$	Pts. $CaCl_2$	Pts. $CaSO_4$
0·00	0·225	19·80	0·041
11·50	0·078	51·00	0·000
14·39	0·063	67·05	0·000

(Tilden and Shenstone.)

Solubility of $CaSO_4$ in $CaCl_2+Aq$ at t°.

t°	% $CaCl_2$	% $CaSO_4$	t°	% $CaCl_2$	% $CaSO_4$
15	15·00	0·063	94	15·16	0·110
21	14·70	0·068	138	14·70	0·071
39	15·00	0·091	170	14·82	0·031
72	14·90	0·100	195	14·70	0·022

(Tilden and Shenstone, *l.c.*)

$MgCl_2+Aq$.

Sol. in 324 pts. $MgCl_2+Aq$ (34·1 % $MgCl_2$) at 19°. (Karsten.)

1 g. $CaSO_4$ is sol. in 146 ccm. $\frac{1}{5}$ sat. $MgCl_2+Aq$ at 13·5°. (Fassbender.)

1 l. $\frac{1}{5}$ sat. $MgCl_2+Aq$ dissolves 6·83 g. $CaSO_4+2H_2O$ at 13·5°. (Droeze.)

Solubility of $CaSO_4$ in $MgCl_2+Aq$.

t°	% $MgCl_2$	% $CaSO_4$
9	19·7	0·765
39	11·1	2·744
80	9·99	1·038

(Tilden and Shenstone, *l.c.*)

NH_4NO_3+Aq.

1 g. $CaSO_4$ is sol. in 320 ccm. sat. NH_4NO_3+Aq at 8-9°; in 54 ccm. $\frac{2}{5}$ sat. NH_4NO_3+Aq at 13·5°; in 103 ccm. $\frac{2}{27}$ sat. NH_4NO_3+Aq at 13·5°. (Fassbender.)

KNO_3+Aq.

1 g. $CaSO_4$ is sol. in 94 ccm. sat. KNO_3+Aq at 13·5°; in 82 ccm. sat. KNO_3+Aq at 15·5°; in 68 ccm. nearly sat. KNO_3+Aq at 20°. (Fassbender.)

$NaNO_3+Aq$.

1 g. $CaSO_4$ is sol. in 92 ccm. sat. $NaNO_3+Aq$ at 8·5°; in 318 ccm. $\frac{1}{8}$ sat. $NaNO_3+Aq$ at 13·5°. (Fassbender.)

100 ccm. sat. $NaNO_3$+Aq dissolve 1·086 g. $CaSO_4+2H_2O$; 100 ccm. $\frac{1}{3}$ sat. $NaNO_3$+Aq dissolve 0·314 g. $CaSO_4+2H_2O$. (Droeze, B. **10.** 338.)

KCl+Aq.

1 g. $CaSO_4$ is sol. in 162 ccm. sat. KCl+Aq at 8°; in 295 ccm. $\frac{1}{5}$ sat. KCl+Aq at 9°.

NaCl+Aq.

Sol. in 122 pts. sat. NaCl+Aq. (Anthon.)

Insol. in sat. NaCl+Aq, but more sol. in dil. NaCl+Aq than in H_2O. Maximum solubility in NaCl+Aq is when the sp. gr. is 1·033.

1 g. $CaSO_4$ is sol. in 147 ccm. of sat. NaCl+Aq at 8·5°; in 150 ccm. of sat. NaCl+Aq at 13·5°; in 149 ccm. of $\frac{1}{3}$ sat. NaCl+Aq at 13·5°; in 244 ccm. of $\frac{1}{5}$ sat. NaCl+Aq at 13·5°. (Fassbender.)

100 ccm. sat. NaCl+Aq dissolve 0·6785 g. $CaSO_4+2H_2O$ at 8·5°; 0·6665 g. $CaSO_4+2H_2O$ at 13·5°. 100 ccm. $\frac{1}{3}$ sat. NaCl+Aq dissolve 0·671 g. $CaSO_4+2H_2O$ at 13·5°; $\frac{1}{5}$ sat. NaCl+Aq dissolve 0·4085 g. $CaSO_4+2H_2O$ at 13·5°. (Droeze.)

Solubility of $CaSO_4$ in NaCl+Aq at t°.

t°	% NaCl	% $CaSO_4$	t°	% NaCl	% $CaSO_4$
20	19·90	0·823	130	19·92	0·392
44	19·93	0·830	165	20·04	0·250
67	19·95	0·832	169	20·05	0·244
85	19·90	0·823	179	20·10	0·229
101	20·08	0·682	225	21·00	0·178

(Tilden and Shenstone, Roy. Soc. Proc. **38.** 331.)

Solubility of $CaSO_4$ in NaCl+Aq at t°.

t°	% NaCl	100 ccm. dissolve g. of $CaSO_4$	t°	% NaCl	100 ccm. dissolve g. of $CaSO_4$
21·5	3·53	0·5115	17·5	17·46	0·7369
19·5	7·35	0·6429	101·0	3·53	0·4891
21	11·12	0·7215	102·5	14·18	0·6248
18	14·18	0·7340	103	17·46	0·6299

(Lunge, J. Soc. Chem. Ind. **4.** 31.)

100 pts. H_2O containing pts. NaCl dissolve pts. $CaSO_4$ at 20°.

Pts. NaCl	Pts. $CaSO_4$	Pts. NaCl	Pts. $CaSO_4$	Pts. NaCl	Pts. $CaSO_4$
0·00	0·225	5·05	6·34	24·40	0·820
0·52	0·301	10·00	7·38	35·10	0·734
2·03	0·441	20·00	0·823	35·86	0·709
5·02	6·15	...	...	...	...

(Tilden and Shenstone.)

$(NH_4)_2SO_4$+Aq.

Sol. in 287 pts. $(NH_4)_2SO_4$+Aq (1 : 4). (Fresenius, Z. anal. **30.** 593.)

1 g. $CaSO_4$ is sol. in 327 ccm. sat. $(NH_4)_2SO_4$+Aq at 9°; in 369 ccm. $\frac{1}{7}$ sat. $(NH_4)_2SO_4$+Aq at 13·5°. (Fassbender.)

$MgSO_4$+Aq.

Insol. in sat. $MgSO_4$+Aq.

1 g. $CaSO_4$ is sol. in 1162 ccm. $\frac{1}{10}$ sat. $MgSO_4$+Aq at 13·5°. (Fassbender, B. **9.** 1360.)

Sol. in 635 pts. sat. $MgSO_4$+Aq at 19°. (Karsten.)

Absolutely insol. in sat. $MgSO_4$+Aq, and pptd. from aqueous solution by the addition of $MgSO_4$. (Droeze, B. **10.** 340.)

1 l. $\frac{1}{10}$ sat. $MgSO_4$+Aq dissolves 0·86 g. $CaSO_4+2H_2O$. (Droeze.)

Na_2SO_4+Aq.

1 g. $CaSO_4$ is sol. in 398 ccm. sat. Na_2SO_4+Aq at 10·5°.

K_2SO_4+Aq.

1 g. $CaSO_4$ is sol. in 2325 ccm. sat. K_2SO_4+Aq. at 13·5°; in 664 ccm. $\frac{1}{5}$ sat. K_2SO_4+Aq at 13·5°.

Insol. in alcohol. of 0·905 sp. gr. or less. (Anthon, J. pr. **14.** 125.)

Sol. in dil. alcoholic solutions of NH_4NO_3, KNO_3, $NaNO_3$, NH_4Cl, KCl, and NaCl. (Margueritte, C. R. **38.** 308.)

100 pts. glycerine dissolve 0·957 pt. $CaSO_4$+$2H_2O$, and solubility increases with the temp. (Asselin, C. R. **76.** 884.)

Min. *Anhydrite.*

+$2H_2O$. Min. *Gypsum.*

+$\frac{1}{2}H_2O$. Plaster of Paris contains $\frac{1}{2}H_2O$ according to Chatelier (C. C. **1889**, **1.** 203).

Calcium hydrogen sulphate, $CaH_2(SO_4)_2$.

100 pts. H_2SO_4 of 1·82 sp. gr. dissolve about 2 pts. $CaSO_4$; 100 pts. fuming H_2SO_4 dissolve 10·17 pts. $CaSO_4$ (Struve, Z. anal. **9.** 34); 100 pts. H_2SO_4 dissolve 2·5 pts. $CaSO_4$ (Lies-Bodart and Jacquemin, C. R. **46.** 1206); $CaSO_4$ is precipitated by H_2O from H_2SO_4 solution.

100 pts. boiling H_2SO_4 dissolve 10 pts. $CaSO_4$. (Schultz, Pogg. **133.** 137.)

Decomp. by H_2O.

Calcium ***hexa*****hydrogen sulphate,** $CaH_6(SO_4)_4$.

Decomp. by H_2O. (Schultz, Pogg. **133.** 137.)

Calcium magnesium potassium sulphate, $2CaSO_4$, $MgSO_4$, $K_2SO_4+2H_2O$.

Min. *Polyhalite.* Sol. in H_2O with residue of $CaSO_4$.

$4CaSO_4$, $MgSO_4$, $K_2SO_4+2H_2O$. Min. *Krugite.* Decomp. by H_2O.

Calcium potassium sulphate, $CaK_2(SO_4)_2+H_2O$.

Min. *Syngenite.* Sol. in 400 pts. H_2O. (Zepharovitch.) Less sol. than K_2SO_4. Decomp. by heating with separation of $CaSO_4$. Decomp. by H_2O until 25 g. K_2SO_4 are dissolved in a litre, after which there is no decomposition. (Ditte, C. R. **84.** 86.)

Easily sol. in dil. acids. (Phillips.)

$Ca_2K_2(SO_4)_3+3H_2O$. Decomp. by cold H_2O. (Ditte, C. R. **84.** 867.)

Calcium rubidium sulphate, $Ca_2Rb_2(SO_4)_3+3H_2O$.

Decomp. by H_2O. (Ditte, C. R. **84.** 86.)

Calcium sodium sulphate, $CaNa_2(SO_4)_2$.

Min. *Glauberite*. Gradually sol. in H_2O, but crystals of $CaSO_4+2H_2O$ soon separate out. (Fritzsche.)

Insol. in alcohol, and conc. $NaC_2H_3O_2+Aq$; decomp. by H_2O. (Folkhard, C. N. **43.** 6.)

$CaNa_4(SO_4)_3+2H_2O$. Decomp. by H_2O. (Fritzsche.)

Calcium uranium sulphate.

Min. *Uranochalcite*.

Min. *Medjidite*. Easily sol. in dil. $HCl+Aq$.

Cerous sulphate, $Ce_2(SO_4)_3$.

Anhydrous cerous sulphate is much more sol. in H_2O than the hydrated salt.

Easily sol. in cold H_2O if added thereto in small amounts. If large amount of $Ce_2(SO_4)_3$ is treated with a little H_2O it hardens with evolution of heat, and becomes very difficultly soluble. 100 pts. H_2O dissolve 161 pts. $Ce_2(SO_4)_3$ at 0° and 17·86 pts. at 19°.

$Ce_2(SO_4)_3+Aq$ sat. in cold deposits $Ce_2(SO_4)_3$ at 75°, and only 2·25 pts. remain in solution at 100°. (Jolin, Bull. Soc. (2) **21.** 536.)

100 pts. H_2O dissolve 8·31 pts. $Ce_2(SO_4)_3$ at 20°; 8·08 pts. at 45°; 4·95 pts. at 60°; 0·504 pt. at 100°. (Bührig, J. pr. (2) **12.** 240.)

60 pts. anhydrous salt dissolve quickly at 0-3° in 100 pts. H_2O.

At 15° the solution solidifies, and the mother liquor contains only 27·88 % $Ce_2(SO_4)_3$. At 15° the maximum attainable strength is 31·62 % $Ce_2(SO_4)_3$. (Brauner, Chem. Soc. **53.** 357.)

$+5H_2O$. Much less sol. in H_2O than the $8H_2O$ salt. (Jolin.)

$+6H_2O$. As the $5H_2O$ salt. (Hermann.)

$+8H_2O$. 100 pts. H_2O dissolve 14·92 pts. $Ce_2(SO_4)_3$ at 20° from $Ce_2(SO_4)_3+8H_2O$. (Jolin.)

$+9H_2O$. 100 pts. H_2O dissolve 17·52 pts. $Ce_2(SO_4)_3$ from $Ce_2(SO_4)_3+9H_2O$. (Brauner.)

$+12H_2O$. (Marignac.)

Sp. gr. of $Ce_2(SO_4)_3+Aq$ was found to be constant whether $Ce_2(SO_4)_3$ or $Ce_2(SO_4)_3+8H_2O$ was used. The following results were obtained at 15°.

Pts. $Ce_2(SO_4)_3$ to 100 pts. H_2O	Sp. gr.	Pts. $Ce_2(SO_4)_3$ to 100 pts. H_2O	Sp. gr.
3·17	1·03005	12·66	1·11917
6·11	1·05812	14·56	1·13665
8·35	1·07910	15·64	1·14623
9·61	1·09085	21·19	1·19640
10·55	1·09939	31·62	1·28778
11·66	1·10987	...	...

(Brauner, Chem. Soc. **53.** 357.)

4·5 pts. $Ce_2(SO_4)_3$ dissolve in 100 pts. H_2SO_4. (Wyrouboff, Bull. Soc. (3) **2.** 745.)

Ceroceric sulphate, $Ce_2(SO_4)_3$, $2Ce(SO_4)_2+24H_2O$.

Decomp. by H_2O. Sol. in $HCl+Aq$ with decomp. (Mendelejeff, A. **168.** 45.)

$Ce_2(SO_4)_3$, $3Ce(SO_4)_2+31H_2O$. (Jolin.)

Ceric sulphate, basic, CeO_2, SO_3+2H_2O.

Very sl. sol. in H_2O.

Sol. in 2500 pts. H_2O. (Mosander.)

Boiling H_2O gradually dissolves out H_2SO_4. (Erk.)

Sol. in acids.

$8CeO_2$, $7SO_3+12H_2O$; $8CeO_2$, $7SO_3+15H_2O$; $6CeO_2$, $5SO_3+5H_2O$; $4CeO_2$, $3SO_3+7H_2O$; and $3Ce(SO_4)_2$, $5Ce(OH)_4$. All are insol. ppts.

Ceric sulphate, $Ce(SO_4)_2+4H_2O$.

Sol. in H_2O with immediate decomp. (Rammelsberg.)

Cerous hydrogen sulphate, $Ce_2(SO_4)_3$, $3H_2SO_4$.

Decomp. by H_2O. (Wyrouboff, Bull. Soc. (3) **2.** 745.)

Cerous potassium sulphate, $Ce_2(SO_4)_3$, $K_2SO_4+2H_2O$.

Sl. sol. in H_2O; insol. in sat. K_2SO_4+Aq. (Czudnowicz, J. pr. **80.** 26.)

$2Ce_2(SO_4)_3$, $3K_2SO_4$. As above. (Hermann, J. pr. **30.** 188.)

$Ce_2(SO_4)_3$, $2K_2SO_4+3H_2O$. As above. (Jolin.)

$Ce_2(SO_4)_3$, $3K_2SO_4$. Sol. in about 56 pts. H_2O at 9-20°. Easily sol. in acidified H_2O. Nearly insol. in sat. K_2SO_4+Aq. (Jolin.)

Ceric potassium sulphate, $Ce(SO_4)_2$, $2K_2SO_4+2H_2O$.

Sl. sol. in H_2O with decomp. Insol. in sat. K_2SO_4+Aq.

Cerous sodium sulphate, $Ce_2(SO_4)_3$, $Na_2SO_4+2H_2O$.

Very sl. sol. in H_2O, and still less in Na_2SO_4+Aq. 100 ccm. sat. Na_2SO_4+Aq dissolve an amount corresponding to 6·2 mg. Ce_2O_3. (Jolin.)

Sl. sol. in $HCl+Aq$. (Czudnowicz.)

Cerous thallous sulphate, $Ce_2(SO_4)_3$, $3Tl_2SO_4$.

Ppt.

$Ce_2(SO_4)_3$, $Tl_2SO_4+2H_2O$. Sol. in H_2O. (Zschiesche, J. pr. **107.** 98.)

$+4H_2O$. Very sl. sol. in cold, somewhat more in warm H_2O. (Wyrouboff, Bull. Soc. Min. **14.** 83.)

Chromous sulphate, $CrSO_4+7H_2O$.

100 pts. H_2O dissolve 12·35 pts. $CrSO_4+7H_2O$. Aqueous solution can be boiled without decomp. Sl. sol. in alcohol.

$+H_2O$. (Moissan, Bull. Soc. **37.** 296.)

Chromic sulphate, basic, $3Cr_2O_3$, $2SO_3+12H_2O=2Cr_2(SO_4)(OH)_4,Cr_2(OH)_6+5H_2O$.

Insol. in H_2O. Sol. in acids. Slowly decomp. by $KOH+Aq$ or K_2CO_3+Aq.

$5Cr_2O_3$, $3SO_3$. Sol. in H_2O. (Recoura, C. R. **112.** 1439.)

Cr_2O_3, $SO_3=Cr_2O_2(SO_4)$. Ppt. (Schiff, A. **124.** 167.)

$5Cr_2O_3$, $8SO_3$ (?). (Siewert, A. **126.** 97.)

Cr_2O_3, $2SO_3=Cr_2O(SO_4)_2$. Easily sol. in a little H_2O, but a precipitate is thrown down by further addition of H_2O, which redissolves on evaporation.

$5Cr_2O_3, 12SO_3$ (?). (Siewert.)

Chromic sulphate, $Cr_2(SO_4)_3$.

Anhydrous. Insol. in H_2O, HNO_3, HCl, H_2SO_4, aqua regia, and NH_4OH+Aq. Decomp. by boiling caustic alkalies, and slowly by alkali carbonates+Aq. (Schrötter.) According to Traube (A. **71.** 92) and Siewert (A. **126.** 94), Schrötter's salt is an acid sulphate, $Cr_4(SO_4)_5(OSO_2OH)_2=2Cr_2(SO_4)_3, H_2SO_4$. According to Étard (Bull. Soc. (2) **31.** 200) both salts exist, and formula of above salt is $Cr_2(SO_4)_6Cr_2$. Formula is $2[(Cr_2O_3)_2, (SO_3)_6], 17H_2SO_4$ (?). (Cross and Higgins, Chem. Soc. **41.** 113.)

$+6H_2O$ (?). *Green modification.* Readily sol. in H_2O or alcohol. Sol. in conc. H_2SO_4. H_2O solution is converted into the violet modification by standing 3-4 weeks. (Schrötter.)

$+11H_2O$ (?). Extremely deliquescent; becomes liquid in moist air in 2 minutes. Not pptd. by $BaCl_2$+Aq. (Recoura, C. R. **113.** 857.)

$+18H_2O$. *Violet modification.* Sol. in 0·833 pt. H_2O at 20°. When the H_2O solution is heated to 65-70° it begins to be converted into the green modification. This conversion is also brought about by cold HNO_3, H_2SO_4, PCl_3. (Étard, C. R. **84.** 1090.)

Sp. gr. of aqueous solution of violet modification of $Cr_2(SO_4)_3$ containing:

5	10	20 % $Cr_2(SO_4)_3+18H_2O$,
1·0275	1·0560	1·1150
30	40	50 % $Cr_2(SO_4)_3+18H_2O$.
1·1785	1·2480	1·3250

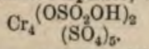
Sp. gr. of aqueous solution of green modification of $Cr_2(SO_4)_3$ containing:

10	20	30 % $Cr_2(SO_4)_3+18H_2O$,
1·0510	1·1070	1·1680
40	50	60 % $Cr_2(SO_4)_3+18H_2O$,
1·2340	1·3055	1·3825
70	80 % $Cr_2(SO_4)_3+18H_2O$.	
1·4650	1·5535	

(Gerlach, Z. anal. **28.** 494.)

See also **Chromosulphuric acid.**

Chromic sulphate, acid, $2Cr_2(SO_4)_3, H_2SO_4=$



$Cr_4\begin{matrix}(OSO_2OH)_2\\(SO_4)_5\end{matrix}$.

Correct composition of $Cr_2(SO_4)_3$ (Traube), which see.

See also **Chromosulphuric acid.**

Chromic cupric sulphate, $Cr_2(SO_4)_3, 2CuSO_4, H_2SO_4$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Chromic ferrous sulphate, $Cr_2(SO_4)_3, 2FeSO_4, H_2SO_4+2H_2O$.

As above. (Étard, *l.c.*)

Chromic ferric sulphate, $Cr_2(SO_4)_3, Fe_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Cr_2(SO_4)_3, Fe_2(SO_4)_3, H_2SO_4$. Insol. in H_2O. (Étard.)

Chromic hydroxylamine sulphate, $Cr_2(SO_4)_3, (NH_2OH)_2SO_4+24H_2O$.

Sol. in H_2O. (Meyeringh.)

Chromic lithium sulphate, $Cr_2(SO_4)_3, 3Li_2SO_4$.

Resembles the corresponding K salt. (Wernicke.)

Chromic manganous sulphate, $Cr_2(SO_4)_3, 3MnSO_4$.

(Étard, C. R. **86.** 1402.)

Chromic manganic sulphate, $Cr_2(SO_4)_3, Mn_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Cr_2(SO_4)_3, Mn_2(SO_4)_3, 2H_2SO_4$. Sl. deliquescent. Sol. in H_2O with decomp. (Étard.)

Chromic nickel sulphate, $Cr_2(SO_4)_3, NiSO_4, 2H_2SO_4+3H_2O$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Chromous potassium sulphate, $CrSO_4, K_2SO_4+6H_2O$.

Sol. in H_2O; less sol. in alcohol. (Peligot, A. ch. (3) **12.** 546.)

Chromic potassium sulphate, $K_2Cr_2(SO_4)_4$.

Anhydrous. *a.* Sol. in H_2O when not heated over 350°.

β. Insol. in cold H_2O and cold acids. When ignited is insol. in hot H_2O and acids, except slightly in boiling conc. H_2SO_4. (Fischer.)

$+2H_2O$ (?). Insol. in cold H_2O or dil. acids. Sol. by long boiling with H_2O, and more quickly when HCl is added. (Hertwig.)

$+4H_2O$. Is potassium chromosulphate, which see.

$+24H_2O$. *Chrome-alum. Violet modification.* Efflorescent at 29°. Sol. in 6-7 pts. cold H_2O. When the H_2O solution is heated to 60-70° it is partially decomp. into a green modification, which is more sol. in H_2O. The green modification on standing in H_2O solution is very slowly converted back into violet modification. The green modification may also be formed by heating dry salt to 100°, at which temp. it melts in its crystal H_2O. When all crystal H_2O has been expelled at 300-350°, it still dissolves in hot H_2O, but when heated above 350° it becomes insol. in H_2O. (Löwel, A. ch. (3) **44.** 313.)

Insol. in alcohol.

Melts in crystal H_2O at 89°. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of chrome-alum solutions at 15° containing:

5	10	15	20	25	% salt,
1·0174	1·0342	1·0524	1·0746	1·1004	
30	35	40	45	50	% salt,
1·1274	1·1572	1·1896	1·2352	1·2894	
55	60	65	70	% salt.	
1·3704	1·4566	1·5462	1·6362		

(Franz, J. pr. (2) **5.** 298.)

Sp. gr. of aqueous solution of violet modification at 15° containing:

5	10	15 % $K_2Cr_2(SO_4)_4+24H_2O$.
1·02725	1·05500	1·08350

Sp. gr. of sat. solution at 15° = 1·0985.

Sp. gr. of aqueous solution of green modification at 15° containing:

10	20	30 % $K_2Cr_2(SO_4)_4+24H_2O$,
1·050	1·103	1·161
40	50	60 % $K_2Cr_2(SO_4)_4+24H_2O$,
1·225	1·295	1·371
70	80	90 % $K_2Cr_2(SO_4)_4+24H_2O$.
1·453	1·541	1·635

(Gerlach, Z. anal. **28**. 497.)

$3K_2SO_4$, $Cr_2(SO_4)_3$. Insol. in H_2O, acids, or dil. alkalies. Decomp. by boiling with conc. KOH+Aq. (Wernicke, Pogg. **159**. 576.)

Chromic rubidium sulphate, $Rb_2Cr_2(SO_4)_4+24H_2O$.

Sol. in H_2O. (Petersson.)

Chromic sodium sulphate, $Na_2Cr_2(SO_4)_4+10H_2O$.

Is sodium chromosulphate, which see.

$+24H_2O$. More efflorescent than K or NH_4 salt. Sol. in H_2O, and properties resemble the corresponding K salt.

$Cr_2(SO_4)_3$, $3Na_2SO_4$. Resembles the corresponding K salt.

Chromic thallous sulphate, $Tl_2Cr_2(SO_4)_4+24H_2O$.

Properties as chromic potassium sulphate.

Chromic sulphate chloride, $Cr_2(SO_4)_2Cl_2+2H_2O$.

Slightly hygroscopic. Sol. in H_2O. (Schiff, A. **124**. 176.)

Cobaltous sulphate, basic.

Ppt. Insol. in H_2O. (Berzelius.)

6CoO, SO_3+10H_2O. (Athanasesco, C. R. **103**. 271.)

5CoO, SO_3+4H_2O. Ppt. Very sl. sol. in H_2O. (Habermann, M. Ch. **5**. 432.)

Cobaltous sulphate, $CoSO_4$.

Anhydrous. (Étard, C. R. **87**. 602.)

$+H_2O$. Sl. sol. in cold, and only very slowly sol. in hot H_2O. (Vortmann, B. **15**. 1888.)

$+4H_2O$. (Fröhde, Arch. Pharm. (2) **127**. 92.)

$+6H_2O$. (Marignac.)

$+7H_2O$. Sol. in 24 pts. cold H_2O. Insol. in alcohol. (Persoz.)

100 pts. H_2O dissolve at:

3°	10°	20°	24°	29°
26·2	30·5	36·4	38·9	40 pts. anhydrous salt,
35°	44°	50°	60°	70°
46·3	50·4	55·2	60·4	65·7 pts. anhydrous salt.

(Tobler, A. **95**. 193.)

100 pts. H_2O at 11-14° dissolve 23·88 pts. anhydrous salt. (v. Hauer, J. pr. **103**. 114.)

Solubility in 100 pts. H_2O at t°, using $CoSO_4+7H_2O$.

t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$
0	24·6	36	43·5	72	65·0
1	25·0	37	44·0	73	65·6
2	25·5	38	44·6	74	66·2
3	26·0	39	45·2	75	66·8
4	26·5	40	45·8	76	67·4
5	27·0	41	46·4	77	68·0
6	27·5	42	47·0	78	68·6
7	28·0	43	47·6	79	69·2
8	28·5	44	48·2	80	69·8
9	29·0	45	48·8	81	70·4
10	29·5	46	49·4	82	71·0
11	30·0	47	50·0	83	71·6
12	30·5	48	50·6	84	72·2
13	31·0	49	51·2	85	72·8
14	31·5	50	51·8	86	73·4
15	32·0	51	52·4	87	74·0
16	32·5	52	53·0	88	74·6
17	33·0	53	53·6	89	75·2
18	33·5	54	54·2	90	75·9
19	34·0	55	54·8	91	76·6
20	34·5	56	55·4	92	77·2
21	35·1	57	56·0	93	77·9
22	35·6	58	56·6	94	78·6
23	36·2	59	57·2	95	79·2
24	36·8	60	57·8	96	79·9
25	37·4	61	58·4	97	80·6
26	38·0	62	59·0	98	81·3
27	38·5	63	59·6	99	81·9
28	39·1	64	60·2	100	82·6
29	39·6	65	60·8	101	83·3
30	40·2	66	61·4	102	83·9
31	40·7	67	62·0	103	84·6
32	41·3	68	62·6	104	85·3
33	41·8	69	63·2	105	86·0
34	42·4	70	63·8	106	86·7
35	42·9	71	64·4	106·4	86·9

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. **1864**. 68.)

Sp. gr. of $CoSO_4$+Aq at t°. S=pts. $CoSO_4$ in 100 pts. solution; S_1=mols. $CoSO_4$ in 100 mols. of solution.

S	S_1	Sp. gr.
6·8910	0·852	1·0765
5·8140	0·711	1·0641
4·7095	0·570	1·0517
3·5792	0·429	1·0392
2·4273	0·288	1·0263
1·2099	0·141	1·0131

(Charpy, A. ch. (6) **29**. 26.)

$HC_2H_3O_2$ ppts. it completely from $CoSO_4$+Aq. (Persoz.)

M.-pt. of $CoSO_4+7H_2O$ = 96-98°. (Tilden, Chem. Soc. **45**. 409.)

100 pts. sat. solution of $CoSO_4$ and $CuSO_4$ contain 22·70 pts. of the two salts.

100 pts. absolute methyl alcohol dissolve 1·04 pts. $CoSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10**. 784.)

100 pts. absolute methyl alcohol dissolve 54·5 pts. $CoSO_4+7H_2O$ at 18°; 100 pts. absolute methyl alcohol dissolve 42·8 pts. $CoSO_4+7H_2O$ at 3°; 100 pts. 93·5 % methyl alcohol dissolve 13·3 pts. $CoSO_4+7H_2O$ at 3°; 100 pts. 50 % methyl alcohol dissolve 1·8 pts. $CoSO_4+7H_2O$ at 3°.

100 pts. absolute ethyl alcohol dissolve 2·5 pts. $CoSO_4+7H_2O$ at 3°. (de Bruyn, Z. phys. Ch. **10**. 786.)

Min. *Bieberite.*

Cobaltocobaltic sulphate, Co_2O_3, $6CoO$, SO_3+15H_2O.

Precipitate. Insol. in boiling $CoSO_4+Aq$ or NH_4OH+Aq. (Gentele, J. pr. **69**. 130.)

Cobaltic sulphate, $Co_2(SO_4)_3+18H_2O$.

Sol. in H_2O with immediate decomp. and liberation of O. Sol. in dil. H_2SO_4+Aq without immediate decomp. Sol. in conc. HNO_3, H_2SO_4, or $HC_2H_3O_2+Aq$. (Marshall, Chem. Soc. **59**. 760.)

Cobaltous cupric sulphate, $2CoSO_4$, $CuSO_4+21H_2O$.

Easily sol. in H_2O. (v. Hauer, Pogg. **125**. 637.)

$+36H_2O$. (Liebig.)

$2CoSO_4$, $2CuSO_4$, H_2SO_4. (Étard.)

Cobaltous cupric magnesium potassium zinc sulphate, $CoSO_4$, $CuSO_4$, $MgSO_4$, $4K_2SO_4$, $ZnSO_4+24H_2O$ (?).

Sol. in H_2O. (Vohl.)

Cobaltous cupric potassium sulphate, $CoSO_4$, $CuSO_4$, $2K_2SO_4+12H_2O$ (?).

Sol. in H_2O. (Vohl.)

Does not exist. (Aston and Pickering, Chem. Soc. **49**. 123.)

Cobaltous ferrous potassium sulphate, $CoSO_4$, Fe_2SO_4, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

$2CoSO_4$, $2FeSO_4$, H_2SO_4. (Étard.)

Cobaltous magnesium sulphate, $3CoSO_4$, $MgSO_4+28H_2O$.

Easily sol. in H_2O. (Winkelblech.)

Cobaltous magnesium potassium sulphate, $CoSO_4$, $MgSO_4$, $K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Does not exist. (Aston and Pickering, Chem. Soc. **49**. 123.)

Cobaltous manganous potassium sulphate, $CoSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Cobaltous nickel potassium sulphate, $CoSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Does not exist. (Thomson, Rep. Brit. Assn. Adv. Sci. **1877**. 209.)

Cobaltous potassium sulphate, $CoSO_4$, $K_2SO_4+6H_2O$.

Less sol. in H_2O than $CoSO_4$.

100 pts. H_2O dissolve at:

0°	12°	15°	20°	25°
19·1	30	32·5	39·4	45·3 pts. anhydrous salt,

30°	35°	40°	49°
51·9	55·4	64·6	81·3 pts. anhydrous salt.

(Tobler, A. **96**. 126.)

100 pts. saturated solution contain at:

20°	40°	60°	80°
14	19·5	24·4	31·8 pts. anhydrous salt.

(v. Hauer, J. pr. **74**. 433.)

Cobaltic potassium sulphate, $K_2Co_2(SO_4)_4+24H_2O$.

Sol. in H_2O with decomp. (Marshall, Chem. Soc. **59**. 760.)

Cobaltous potassium zinc sulphate, $CoSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Cobaltous rubidium sulphate, $CoSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cobaltous zinc sulphate.

Efflorescent. Decomp. on air. (Link, Crell. Ann. **1790**, **1**. 32.)

Cobaltous sulphate ammonia, $CoSO_4$, $6NH_3$.

Sol. in H_2O with separation of ppt. (Rose, Pogg. **20**. 152.) Very easily sol. in NH_4OH+Aq. (Fremy.)

Decomp. by alcohol.

Columbium sulphate.

Sol. in H_2O. (Blomstrand.)

Cupric sulphate, basic, $8CuO$, SO_3+12H_2O.

Ppt. (Kane, A. ch. **72**. 269.)

$5CuO$, SO_3+6H_2O. Ppt. (Smith, Phil. Mag. J. **23**. 196.)

$4CuO$, SO_3+3H_2O. Insol. in H_2O. (Roucher, J. Pharm. (3) **37**. 50.)

Min. *Brochantite.* Sol. in acids and NH_4OH+Aq.

$+3\frac{1}{2}H_2O$. Insol. in H_2O. Easily sol. in dil. acids, even $HC_2H_3O_2+Aq$. Sl. sol. in $CuSO_4+Aq$. Insol. in $NaC_2H_3O_2+Aq$. (Casselmann, Z. anal. **4**. 24.)

$+4H_2O$. Insol. in H_2O. (Proust.) Sol. in $(NH_4)_2SO_4+Aq$, and more easily in NH_4Cl, and NH_4NO_3+Aq. (Lea.)

$+5H_2O$. Min. *Langite.*

$+16H_2O$. (André, C. R. **100**. 1138.)

$7CuO$, $2SO_3+5H_2O$. (Reindel, J. pr. **100**. 1.)

$+6H_2O$. Wholly insol. in cold or hot H_2O. (Habermann, M. Ch. **5**. 432.)

$+7H_2O$. Insol. in H_2O; easily sol. in acids. Insol. in boiling $CuSO_4+Aq$. (Reindel.)

$3CuO$, $SO_3+1\frac{1}{2}H_2O$. Insol. in H_2O; easily sol. in acids. (Steinmann, B. **15**. 1412.)

$+2H_2O$. Insol. in H_2O; sol. in dil. H_2SO_4+Aq. (Shenstone, Chem. Soc. **47**. 375.)

$+2\frac{1}{2}H_2O$. (Reindel, J. pr. **102**. 204.)

$+4H_2O$. Insol. in H_2O. (Grimbert and Barré, J. Pharm. (5) **21**. 414.)

$2CuO, SO_3$. Decomp. by cold H_2O into $CuSO_4$ and $4CuO, SO_3$. (Roucher.)

According to Pickering (C. N. **47**. 181) only $3CuO, SO_3+2\frac{1}{2}H_2O$ and $4CuO, SO_3+4H_2O$ are true chemical compounds.

Cupric sulphate, $CuSO_4$.

Anhydrous. Absorbs H_2O from the air. Combines with, and dissolves in H_2O with great evolution of heat.

$+H_2O$. Permanent. Sol. in H_2O. (Étard, C. R. **87**. 602.)

$+2H_2O$ (?). (Storer's Dict.)

$+3H_2O$. (Étard, C. R. **104**. 1614.)

Does not exist. (Cross, C. N. **49**. 220.)

$+5H_2O$. Superficially efflorescent in dry air.

Sol. in 2·34 pts. H_2O at 18°, and sat. solution has sp. gr. 1·2147. (Schiff, A. **109**. 326.)

100 pts. $CuSO_4$+Aq sat. at b.-pt., 102·2°, contain 45 pts. of the dry salt, or 100 pts. H_2O at 102·2° dissolve 81·82 pts. $CuSO_4$. (Griffiths, Q. J. Sci. **18**. 90.)

Sol. in less than 4 pts. H_2O at ord. temp., and much more sol. in boiling H_2O. (Bergmann.)

Sol. in 4 pts. cold, and 2 pts. hot H_2O. (Schubarth.)

100 pts. H_2O dissolve 33·103 pts. $CuSO_4+5H_2O$ at 15°, and solution has sp. gr. = 1·1859. (Michel and Krafft, A. ch. (3) **41**. 478.)

$CuSO_4$+Aq sat. at 8° has 1·17 sp. gr. (Anthon, A. **24**. 210.)

1 pt. $CuSO_4+5H_2O$ dissolves at:

	4°	19°	31°	37·5°	50°	
in	3·32	2·71	1·84	1·7	1·14	pts. H_2O,
	62·5°	75°	87·5°	100°	104°	
in	1·27	1·07	0·75	0·55	0·47	pts. H_2O.

(Brandes and Gruner, **1826**.)

Sol. at 17·5° in 2·412 pts. H_2O. (Karsten.)

100 pts. H_2O dissolve at:

9°	10°	20°	30°	
31·61	36·95	42·31	48·81	pts. $CuSO_4+5H_2O$,
40°	50°	60°	70°	
56·90	65·83	77·39	94·60	pts. $CuSO_4+5H_2O$,
80°	90°	100°		
118·03	156·44	203·32	pts. $CuSO_4+5H_2O$.	

(Poggiale, A. ch. (3) **8**. 463.)

100 pts. H_2O dissolve at:

0°	20°	35°	54°	
17	24·3	28·6	36·1	pts. anhydrous $CuSO_4$.

(Tobler, A. **95**. 193.)

100 pts. $CuSO_4$+Aq sat. at 11-14° contain 16·23 pts. anhydrous $CuSO_4$. (v. Hauer, J. pr. **103**. 114.)

100 pts. H_2O dissolve 15·107 pts. $CuSO_4$ at 0°. (Pfaff, A. **99**. 224.)

100 pts. H_2O dissolve pts. $CuSO_4$ at t°.

t°	Pts. $CuSO_4$
0	14·99
17·9	20·16
24·1	22·37

(Diacon, J. B. **1866**. 61.)

100 pts. H_2O dissolve pts. $CuSO_4$ at t°.

t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$
0	14·15	40	28·50	80	54·53
10	17·50	50	33·31	90	64·35
20	20·53	60	39·01	100	75·22
30	24·34	70	45·74	...	...

(Patrick and Aubert, Transactions of Kansas Acad. of Sci. **1874**. 19.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$
0	15·5	35	27·5	70	45·7
1	16·3	36	27·9	71	46·4
2	16·6	37	28·3	72	47·2
3	16·9	38	28·7	73	47·9
4	17·2	39	29·1	74	48·7
5	17·5	40	29·5	75	49·5
6	17·8	41	29·9	76	50·3
7	18·1	42	30·3	77	51·1
8	18·4	43	30·7	78	51·9
9	18·7	44	31·1	79	52·7
10	19·1	45	31·5	80	53·5
11	19·3	46	31·9	81	54·3
12	19·6	47	32·3	82	55·1
13	19·9	48	32·7	83	55·9
14	20·2	49	33·2	84	56·8
15	20·5	50	33·6	85	57·8
16	20·8	51	34·1	86	58·7
17	21·1	52	34·5	87	59·7
18	21·4	53	35·0	88	60·7
19	21·7	54	35·5	89	61·7
20	22·0	55	36·0	90	62·7
21	22·3	56	36·6	91	63·7
22	22·6	57	37·2	92	64·8
23	23·0	58	37·8	93	65·8
24	23·3	59	38·4	94	66·9
25	23·7	60	39·0	95	68·0
26	24·0	61	39·6	96	69·1
27	24·4	62	40·2	97	70·2
28	24·7	63	40·9	98	71·3
29	25·1	64	41·5	99	72·4
30	25·5	65	42·2	100	73·5
31	25·9	66	42·9	101	74·6
32	26·3	67	43·6	102	75·7
33	26·7	68	44·3	103	76·8
34	27·1	69	45·0	104	77·95

(Mulder, Scheik. Verhandel. **1864**. 79.)

If solubility S = pts. anhydrous $CuSO_4$ in 100 pts. solution, $S=11·6+0·2614t$ from −2° to 55°; $S=26·5+0·3700t$ from 55° to 105°; $S=45·0-0·0293t$ from 105° to 190°. (Étard, C. R. **104**. 1614.)

Solubility decreases above 120°, owing to formation of basic salt. (Tilden and Shenstone, Phil. Trans. **1884**. 23.)

100 ccm. H_2O dissolve 14·92 g. $CuSO_4$ at 0°. (Engel, C. R. **102**. 113.)

100 ccm. H_2O dissolve 22·28-22·30 g. $CuSO_4$ at 20°. (Trevor, Z. phys. Ch. **7**. 468.)

$+6H_2O$. (Boisbaudran, C. R. **66.** 487.)
$+7H_2O$. (Boisbaudran, C. R. **65.** 1249.)

Sp. gr. of $CuSO_4+Aq$ at 18°. %=% $CuSO_4+5H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·0063	11	1·0716	21	1·1427
2	1·0126	12	1·0785	22	1·1501
3	1·0190	13	1·0854	23	1·1585
4	1·0254	14	1·0923	24	1·1659
5	1·0319	15	1·0993	25	1·1738
6	1·0384	16	1·1063	26	1·1817
7	1·0450	17	1·1135	27	1·1898
8	1·0516	18	1·1208	28	1·1980
9	1·0582	19	1·1281	29	1·2063
10	1·0649	20	1·1354	30	1·2146

(Schiff, calculated by Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $CuSO_4+Aq$ at 23·9°. a=No. of ½ mols. in grms. dissolved in 1000 grms. H_2O; b=sp. gr. if a is $CuSO_4+5H_2O$ (½ mol. wt.=125); c=sp. gr. if a is $CuSO_4$ (½ mol. wt.=80).

a	b	c
1	1·076	1·080
2	1·142	1·154
3	1·200	1·225

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $CuSO_4+Aq$ at 15°. %=% $CuSO_4+5H_2O$.

%	Sp. gr.	%	Sp. gr.
5	1·0335	20	1·1443
10	1·0688	25	1·1848
15	1·1060	mother liquor	1·185

(Gerlach, Dingl. **181.** 131.)

Sp. gr. of $CuSO_4+Aq$ at 18°.

% $CuSO_4$	Sp. gr.	% $CuSO_4$	Sp. gr.
5	1·0513	15	1·1675
10	1·1073	17·5	1·2003

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $CuSO_4+Aq$ at 0°. S=pts. $CuSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
11·9315	1·1371	5·2181	1·0578
9·8159	1·1108	2·6460	1·0290
7·5474	1·0833	...	...

(Charpy, A. ch. (6) **29.** 26.)

Sat. $CuSO_4+Aq$ boils at 102·2°, and contains 81·8 pts. $CuSO_4$ to 100 pts. H_2O. (Griffiths.)

Crust forms at 102·3°, and solution contains 60·3 pts. $CuSO_4$ to 100 pts. H_2O; highest temp. observed, 104·8°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. $CuSO_4+Aq$ containing pts. $CuSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $CuSO_4$	B.-pt.	Pts. $CuSO_4$
100·5°	21·3	103·0°	69·0
101·0	36·9	103·5	74·9
101·5	48·0	104·0	80·1
102·0	56·2	104·2	82·2
102·5	63·0	...	...

(Gerlach Z. anal. **26.** 434.)

Sol. in $HCl+Aq$, causing a reduction of temperature of about 17°.

Very sl. sol. in conc. H_2SO_4. (Schulz.)

Glacial acetic acid precipitates $CuSO_4$ completely from $CuSO_4+Aq$.

Sol. in sat. Na_2SO_4+Aq. (Karsten.)

Solubility of $CuSO_4$ in presence of Na_2SO_4 at 0°. 100 pts. H_2O dissolve—

No.	$CuSO_4$	Na_2SO_4	No.	$CuSO_4$	Na_2SO_4
1	0	4·53	5	15·84	3·55
2	6·01	5·34	6	15·33	1·98
3	9·81	5·73	7	14·99	0
4	16·67	6·48	...	...	...

In 1, 2, and 3, Na_2SO_4 was in excess and given amt. $CuSO_4$ added; in 4, both $CuSO_4$ and Na_2SO_4 were in excess; in 5, 6, and 7, $CuSO_4$ was in excess and Na_2SO_4 added. (Diacon, J. B. **1866.** 61.)

100 pts. H_2O dissolve 8·038 pts. $CuSO_4$ and 6·31 pts. Na_2SO_4 at 0°. (Pfaff, A. **99.** 224.)

100 pts. H_2O dissolve 20·7 pts. $CuSO_4$ and 15·9 pts. Na_2SO_4 at 15°. (Rüdorff, B. **6.** 484.)

100 pts. H_2O dissolve 10·85 pts. $CuSO_4$, 17·47 pts. $MgSO_4$, and 5·78 pts. Na_2SO_4 at 0°. (Diacon.)

100 pts. H_2O dissolve 7·169 pts. $CuSO_4$, 21·319 pts. $MgSO_4$, and 6·830 pts. Na_2SO_4 at 0°. (Pfaff.)

Slowly and sl. sol. in sat. $MgSO_4+Aq$. (Karsten.)

Solubility of $CuSO_4$ in H_2O in presence of $MgSO_4$. 100 pts. H_2O dissolve—

No.	$CuSO_4$	$MgSO_4$	No.	$CuSO_4$	$MgSO_4$
1	0	26·37	5	12·03	15·67
2	2·64	25·91	6	13·61	8·64
3	4·75	25·30	7	14·99	0
4	9·01	23·54	...	...	...

In 1, 2, 3, $MgSO_4$ was in excess and given amt. $CuSO_4$ added; in 4, both $CuSO_4$ and $MgSO_4$ were in excess; in 5, 6, and 7, $CuSO_4$ was in excess. (Diacon, *l.c.*)

100 pts. sat. solution of $CuSO_4$ and $MgSO_4$ contain 28·58 pts. of the salts at 11-14°. (v. Hauer, J. pr. **103.** 114.)

100 pts. sat. solution of $CuSO_4$ and $NiSO_4$

contain 31·03 pts. of the salts at 11-14°. (v. Hauer.)

100 pts. sat. solution of $CuSO_4$ and $MnSO_4$ contain 37·09 pts. of the salts at 11-14°. (v. Hauer.)

Very slowly sol. in sat. $ZnSO_4+Aq$, forming a double salt which separates. (Karsten.)

100 pts. sat. solution of $CuSO_4$ and $ZnSO_4$ contain 32·70 pts. of the salts at 11-14°. (v. Hauer.)

100 pts. sat. solution of $CuSO_4$ and $FeSO_4$ contain 17·43 pts. of the salts at 11-14°. (v. Hauer, J. pr. **103.** 114.)

More easily sol. in sat. K_2SO_4+Aq than in Na_2SO_4 or $MgSO_4+Aq$, forming a double sulphate, which separates out. (Karsten.)

K_2SO_4 and $CuSO_4$ mutually displace each other in saturated solutions. (Rüdorff, Pogg. **148.** 555.)

When K_2SO_4 and $CuSO_4$, both in excess, are dissolved in H_2O, a maximum of solubility of 15·61 pts. of the two salts in 100 pts. H_2O at 25° is reached in 30 minutes, after which the solubility decreases. This result is obtained either by treating excess of the two salts with H_2O at 25°, or cooling solutions of the two salts sat. at higher temp. to 25°. The salts are in the proportion of 5·2 pts. K_2SO_4 to 10·4 pts. $CuSO_4$. If present in the same proportion as in their saturated solutions, 5·41 pts. K_2SO_4 to 10·13 pts. $CuSO_4$ would be required.

If sat. solution of one salt is added to sat. solution of the other, $K_2Cu(SO_4)_2+6H_2O$ separates, as it is less sol. than either simple salt, until a state of equilibrium is reached, after which there is no separation, contrary to Rüdorff (see above). (Trevor, Z. phys. Ch. **7.** 486.)

Insol. in sat. $(NH_4)_2SO_4+Aq$. (Engel, C. R. **102.** 113.)

Sol. in sat. $NaCl+Aq$.

Sl. sol. in sat. NH_4Cl+Aq, with separation of a double sulphate.

Slowly sol. in sat. KNO_3+Aq, with separation of a double sulphate.

Very slowly sol. in sat. $NaNO_3+Aq$, with separation of a double sulphate. (Karsten, Berl. Abhandl. **1840.** 10.)

100 pts. of a sat. solution in 40 % alcohol contains 0·25 pt. $CuSO_4+5H_2O$; 20 % alcohol, 3·1 pts.; 10 % alcohol, 13·3 pts. (Schiff, A. **118.** 362.)

Anhydrous $CuSO_4$ is sol. in absolute methyl alcohol, but insol. in absolute ethyl alcohol. $CuSO_4+xH_2O$ is insol. in methyl or ethyl alcohol. (Klepl, J. pr. (2) **25.** 526.)

100 pts. absolute methyl alcohol dissolve 1·05 pts. anhydrous $CuSO_4$ at 18°.

100 pts. absolute methyl alcohol dissolve 15·6 pts. $CuSO_4+5H_2O$ at 18°; 100 pts. 93·5 % methyl alcohol dissolve 0·93 pt. $CuSO_4+5H_2O$ at 18°; 100 pts. 50 % methyl alcohol dissolve 0·4 pt. $CuSO_4+5H_2O$ at 18°; 100 pts. absolute methyl alcohol dissolve 13·4 pts. $CuSO_4+5H_2O$ at 3°.

100 pts. absolute ethyl alcohol dissolve 1·1 pts. $CuSO_4+5H_2O$ at 3°. (de Bruyn, Z. phys. Ch. **10.** 786.)

Sol. in glycerine (Pelouze), picoline (Unverdorben).

Anhydrous $CuSO_4$ is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Min. *Chalcanthite.*

Cupric glucinum sulphate, $CuSO_4$, $4GlSO_4+20H_2O$.

Sol. in H_2O. (Klatzo, J. B. **1868.** 205.)

Does not exist. (Marignac, A. ch. (4) **30.** 45.)

$9CuSO_4$, $GlSO_4+50H_2O$. As above.

Does not exist. (Marignac, *l.c.*)

Cupric ferrous sulphate, $CuSO_4$, $FeSO_4$.

Insol. in H_2O. (Étard, C. R. **87.** 602.)

$+2H_2O$. (Étard.)

$CuSO_4$, $2FeSO_4+21H_2O$. Sol. in H_2O. (v. Hauer.)

$CuSO_4$, $3FeSO_4+28H_2O$. 100 pts. H_2O dissolve 75 pts. salt at 7°. (Lefort.)

$4CuSO_4$, $FeSO_4+34H_2O$. 100 pts. H_2O at 15·5° dissolve 75·91 pts. (Thomson.)

Other salts are sol. in H_2O.

Cupric ferric sulphate, $CuSO_4$, $Fe_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (Bastick.)

Cupric ferrous potassium sulphate, $CuSO_4$, $FeSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric lead sulphate, CuO, PbO, SO_3+H_2O.

Min. *Linarite.*

$3CuO$, $7PbO$, $5SO_3+5H_2O$. Min. *Caledonite.* Sol. in HNO_3+Aq.

Cupric magnesium sulphate, $CuSO_4$, $MgSO_4+14H_2O$.

Efflorescent. Sol. in H_2O. (Vohl, A. **94.** 57.)

$+2H_2O$. (Arrot, **1834.**)

$CuSO_4$, $2MgSO_4+21H_2O$. Sol. in H_2O. (v. Hauer, Pogg. **125.** 638.)

$CuSO_4$, $7MgSO_4+56H_2O$. Sol. in H_2O. (Schiff, A. **107.** 64.)

Cupric magnesium manganous potassium sulphate, $CuSO_4$, $MgSO_4$, $MnSO_4$, $3K_2SO_4+18H_2O$.

Sol. in H_2O. (Vohl.)

Cupric magnesium potassium sulphate, $CuSO_4$, $MgSO_4$, $2K_2SO_4+6H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Does not exist. (Aston and Pickering, Chem. Soc. **49.** 123.)

Cupric magnesium potassium zinc sulphate, $CuSO_4$, $MgSO_4$, $3K_2SO_4$, $ZnSO_4+18H_2O$.

Sol. in H_2O. (Vohl.)

Cupric manganous sulphate, $5CuSO_4$, $2MnSO_4+35H_2O$.

Sol. in H_2O. (Schäuffele, J. B. **1852.** 340.)

$2CuSO_4$, $3MnSO_4+25H_2O$. As above. (S.)

$CuSO_4$, $MnSO_4+H_2O$. (Étard, C. R. **87.** 602.)

Cupric manganous potassium sulphate, $CuSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric nickel sulphate, $CuSO_4$, $NiSO_4+3H_2O$. (Étard, C. R. **87**. 602.)

$CuSO_4$, $2NiSO_4+21H_2O$. Sol. in H_2O. (v. Hauer.)

$+18H_2O$. Sol. in H_2O. (Boisbaudran, C. R. **66**. 497.)

$2CuSO_4$, $2NiSO_4$, $3H_2SO_4$. (Étard.)

Cupric nickel potassium sulphate, $CuSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Sol. in 4 pts. H_2O; insol. in alcohol. (Bette.)

$4CuSO_4$, $K_2SO_4+4H_2O$. Very sl. sol. in H_2O.

K_2O, $4CuO$, $4SO_3+4H_2O$. Insol. in H_2O, but decomp. by boiling H_2O into $3CuO$, SO_3.

Cupric potassium sulphate, $K_2Cu(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 66·666 pts. at 102·8°. (Griffiths.)
Much more sol. in hot than cold H_2O. (Pierre.)

Easily sol. in H_2O; by boiling, decomp. into basic salt. (Persoz, A. ch. (3) **25**. 272.)

100 pts. H_2O dissolve 11·14 pts. anhydrous salt at 25°. (Trevor, Z. phys. Ch. **7**. 470.)

See also $CuSO_4$ and K_2SO_4.

Min. *Cyanochroite.*

Cupric potassium zinc sulphate, $CuSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric rubidium sulphate, $CuSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

Cupric sodium sulphate (?).

Slowly deliquescent, and decomp. by H_2O into its constituents. (Graham, Phil. Mag. J. **4**. 420.)

Cupric thallium sulphate, $CuSO_4$, $Tl_2SO_4+6H_2O$.

Decomp. by recrystallising from H_2O. (Willm, A. ch. (4) **5**. 55.)

Cupric zinc sulphate, $CuSO_4$, $3ZnSO_4+28H_2O$.

Efflorescent. 100 pts. H_2O dissolve 80 pts. salt at 8°. Sol. in all proportions in boiling H_2O. (Lefort.)

$CuSO_4$, $2ZnSO_4+21H_2O$. (v. Hauer, Pogg. **125**. 637.)

$CuSO_4$, $ZnSO_4+12H_2O$. (Boisbaudran.)

$2CuSO_4$, $2ZnSO_4$, H_2SO_4. (Étard.)

Cupric sulphate ammonia, basic, $CuSO_4$, $3CuO$, $2NH_3+5H_2O$.

Decomp. by hot H_2O. (Pickering, Chem. Soc. **43**. 336.)

Cupric sulphate ammonia (Cuprammonium sulphate), $CuSO_4$, NH_3.

Decomp. by H_2O. (Kane.)

$CuSO_4$, $2NH_3$ [$CuSO_4$, $2NH_3+3H_2O$. (Mendelejeff, B. **3**. 422.)]. Decomp. by excess of H_2O into—

$CuSO_4$, $4NH_3+H_2O$. Sol. in 1·5 pts. H_2O, but decomp. by much H_2O. Insol. in alcohol. Insol. in conc. NH_4OH+Aq. (André, C. R. **100**. 1138.)

$CuSO_4$, $5NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20**. 150.)

Decipium sulphate, $Dp_2(SO_4)_3$.

Sol. in H_2O.

Cryst. with $9H_2O$, and $24H_2O$. (Delafontaine.)

Didymium sulphate, basic, Di_2O_3, $SO_3=(DiO)_2SO_4$.

Insol. in cold or boiling H_2O. (Marignac.)

Slowly sol. in hot dil. $HCl+Aq$. Easily sol. in conc. acids.

$+8H_2O$. Precipitate. (Hermann.)

Composition is $2Di_2O_3$, $3SO_3+3H_2O$ or $Di_2(SO_4)_3+Di_2O_6H_6$. (Frerichs and Smith.)

Composition is $5Di_2O_3$, $3SO_3+xH_2O$. (Cleve, B. **11**. 910.)

Didymium sulphate, $Di_2(SO_4)_3$.

Anhydrous. By saturating cold H_2O and warming the solution, the following results were obtained—100 pts. H_2O dissolve at:

12°	18°	25°	38°	50°
43·1	25·8	20·6	13·0	11·0 pts. $Di_2(SO_4)_3$.

$+6H_2O$. H_2O dissolves this salt very slowly; 100 pts. H_2O dissolve 13 pts. $Di_2(SO_4)_3$ in 24 hours, and 16·4 pts. in 2 days. If solution is evap. in vacuo until $Di_2(SO_4)_3+8H_2O$ separates out, 34 pts. $Di_2(SO_4)_3$ remain dissolved in 100 pts. H_2O.

$+5H_2O$. (Cleve.)

$+8H_2O$. Solutions of this salt contain at:

19°	40°	50°	100°
11·7	8·8	6·5	1·6 pts. $Di_2(SO_4)_3$.

(Marignac, A. ch. (3) **38**. 170.)

$+9H_2O$. (Zschiesche, J. pr. **107**. 75.)

Didymium potassium sulphate, K_2SO_4, $Di_2(SO_4)_3+2H_2O$.

Sol. in 63 pts. H_2O. Insol. in sat. K_2SO_4+Aq. (Marignac.)

$3K_2SO_4$, $Di_2(SO_4)_3$. Sol. in 83 pts. H_2O at 18°. Insol. in cold, sl. sol. in boiling sat. K_2SO_4+Aq, 100 ccm. of which retain 55 mg. Di_2O_3 in solution. (Cleve.)

$4K_2SO_4$, $Di_2(SO_4)_3$. (Cleve.)

$9K_2SO_4$, $2Di_2(SO_4)_3+3H_2O$. (Cleve.)

Didymium sodium sulphate, $Di_2(SO_4)_3$, Na_2SO_4, and $+2H_2O$.

Sol. in 200 pts H_2O (Marignac), and still less in sat. Na_2SO_4+Aq, 100 ccm. of which dissolve only 70 mg. Di_2O_3 at ord. temp. (Cleve.)

Didymium thallous sulphate, $(Di_2SO_4)_3$, $3Tl_2SO_4$.

Ppt.

$Di_2(SO_4)_3$, $Tl_2SO_4+2H_2O$. Sol. in H_2O. (Zschiesche, J. pr. **107**. 98.)

Erbium sulphate, $Er_2(SO_4)_3$.

Anhydrous. Easily and rapidly sol. in H_2O. 100 pts. H_2O dissolve 43 pts. anhydrous salt at 0°.

$+8H_2O$. Less sol. in H_2O than anhydrous salt. 100 pts. H_2O dissolve 30 pts. $Er_2(SO_4)_3+8H_2O$ (=23 pts. $Er_2(SO_4)_3$) at about 20°; at 100° 100 pts. $Er_2(SO_4)_3+8H_2O$ remain dissolved. Sat. solution deposits crystals when heated to 55°. (Höglund.)

Erbium potassium sulphate, $Er_2(SO_4)_3$, $3K_2SO_4$.
Slowly sol. in H_2O. (Höglund.)

Erbium sodium sulphate, $Er_2(SO_4)_3$, $5Na_2SO_4+7H_2O$.
Sol. in H_2O. (Cleve.)

Gallium sulphate, $Ga_2(SO_4)_3$.
Not deliquescent, but very sol. in H_2O. Sol. in 60 % alcohol; insol. in ether. (Boisbaudran.)

Aqueous solution decomp. into basic salt by boiling, which redissolves, however, on cooling.

Glucinum sulphate, basic, $3GlO$, SO_3+4H_2O.
Sol. in H_2O, but decomp. by heating or dilution. (Berzelius.)

$2GlO$, SO_3+3H_2O. Sol. in H_2O.

$9GlO$, SO_3+14H_2O (?). Precipitate. Insol. in H_2O. (Berzelius.)

According to Debray, this salt when carefully washed is GlO_2H_2.

Glucinum sulphate, $GlSO_4+4H_2O$.
Very sol. in H_2O.

Sol. in its own weight of H_2O at 14°, and in every proportion of boiling H_2O. Less sol. in dil. H_2SO_4+Aq than in water. (Debray, A. ch. (3) **44.** 25.)

Sl. sol. in dilute, insol. in absolute alcohol.

Can be completely pptd. from $GlSO_4+Aq$ by $HC_2H_3O_2$. (Persoz.)

$+7H_2O$. (Klatzo, J. pr. **106.** 233.)

Glucinum ferrous sulphate, $GlSO_4$, $FeSO_4+17\frac{1}{2}H_2O$.
Sol. in H_2O. (Klatzo, J. B. **1868.** 204.)

$3GlSO_4$, $FeSO_4+28H_2O$. Sol. in H_2O. (Klatzo.)

Do not exist. (Marignac, A. ch. (4) **30.** 45.)

Glucinum nickel sulphate, $(Gl, Ni)SO_4+4H_2O$ or $7H_2O$.
(Klatzo, J. B. **1868.** 205.)

Does not exist. (Atterberg, Sv. V. A. F. **1873, 4.** 81.)

Glucinum potassium sulphate, $GlSO_4$, $K_2SO_4+2H_2O$.
Sl. sol. in cold, slowly but more sol. in hot H_2O. (Debray.)

$+3H_2O$. (Klatzo.)

Glucinum potassium hydrogen sulphate, $GlH_2(SO_4)_2$, $2K_2SO_4+4H_2O$.
Easily sol. in H_2O. Partly decomp. by recrystallisation. (Atterberg.)

Glucinum sodium sulphate, $2GlSO_4$, $3Na_2SO_4+18H_2O$.
Sol. in H_2O. (Atterberg.)

Glucinum zinc sulphate, $2GlSO_4$, $3ZnSO_4+35H_2O$.
Sol. in H_2O. (Klatzo, J. B. **1868.** 205.)

Does not exist. (Atterberg.)

Gold (Auroauric) sulphate, $Au_2(SO_4)_2$.
Decomp. by moist air, H_2O, glacial acetic acid, or HNO_3+Aq (1·42 sp. gr.) Insol. in conc. H_2SO_4. (Schottländer, A. **217.** 375.)

Auric sulphate, Au_2O_3, $2SO_3+H_2O$, *or* **Auryl hydrogen sulphate,** $(AuO)HSO_4$.
Deliquescent. Decomp. by H_2O. Sol. in $HCl+Aq$; not attacked by conc. HNO_3+Aq. Sol. in 6 pts. conc. H_2SO_4. (Schottländer.)

Auric potassium sulphate, $Au_2(SO_4)_3$, K_2SO_4.
Not decomp. immediately by cold H_2O. (Schottländer.)

Indium sulphate, $In_2(SO_4)_3$.
Easily sol. in H_2O.

$+9H_2O$. Easily sol. in H_2O.

Indium hydrogen sulphate, $InH(SO_4)_2+4H_2O$.
Very deliquescent. (Meyer.)

Indium potassium sulphate, $InK(SO_4)_2+4H_2O$.
Sol. in H_2O, but decomp. by boiling. (Rössler, J. pr. (2) **7.** 14.)

$(InO)_3K(SO_4)_2+3H_2O$. Insol. in H_2O. (Rössler.)

Indium sodium sulphate, $InNa(SO_4)_2+4H_2O$.
Sol. in H_2O. (Rössler, J. pr. (2) **7.** 14.)

Iodyl sulphate, $(IO)_2(SO_4)_3$.
Possible composition of Weber's (B. **20.** 86) I_2O_5, $3SO_3$.

Iridium sulphate.
Sol. in H_2O or alcohol. (Berzelius.)

Iridium potassium sulphate, $Ir_2(SO_4)_3$, $3K_2SO_4$.
Sol. in H_2O or dil. H_2SO_4+Aq; nearly insol. in sat. K_2SO_4+Aq. (Boisbaudran, C. R. **96.** 1406.)

Iron (Ferrous) sulphate, $FeSO_4$.
$+H_2O$.

$+2H_2O$. Not more sol. in H_2O than gypsum. (Mitscherlich.)

$+3H_2O$. Sol. in H_2O. (Kane.)

$+4H_2O$. Separates from conc. $FeSO_4+Aq$ at 80°.

$+7H_2O$. Efflorescent at 33°.

1 pt. $FeSO_4+7H_2O$ dissolves in 1·6 pts. cold, and 0·3 pt. boiling H_2O.

1 pt. $FeSO_4+7H_2O$ dissolves at:

	10°	15°	25°	33°	46°	60°	84°	90°	100°	
in	1·64	1·43	0·87	0·66	0·44	0·38	0·37	0·27	0·3	pts. H_2O.

(Brandes and Firnhaber, Br. Arch. **7.** 83.)

When boiled with insufficient H_2O for solution a white hydrate is formed which separates out. Solubility increases up to 87·5°, and then diminishes, owing to the above separation. (Brandes, Pogg. **20.** 581.)

Sol. in 2 pts. cold, and 1 pt. boiling H_2O (Fourcroy); sol. in 2 pts. cold H_2O at 18·75° (Abl); sol. in 6 pts. H_2O at moderate heat, and 0·75 pt. at 100°. (Bergmann.)

100 pts. H_2O at 15·5° dissolve 45-50 pts. (Ure's Dict.)

100 pts. H_2O dissolve pts. $FeSO_4$ at t°.

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	15·8	21	27·4	45	42·9
10	19·9	30	32·6	55	47·0
12	21·3	37	36·5	70	56·5
20	26·0	..	..	..	..

(Tobler, A. **95.** 198.)

100 pts. $FeSO_4+Aq$ sat. at 11-14° contain 17·02 % $FeSO_4$. (v. Hauer, J. pr. **103.** 114.)

100 pts. $FeSO_4+Aq$. sat at 15° contain 37·2 % $FeSO_4+7H_2O$; solution has sp. gr. 1·2232. (Schiff, A. **118.** 362.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	7·9	34	37·1	67	65·1
1	8·7	35	38·0	68	65·0
2	9·5	36	38·9	69	64·9
3	10·4	37	39·8	70	64·8
4	11·2	38	40·7	71	64·7
5	12·0	39	41·7	72	64·5
6	12·9	40	42·6	73	64·4
7	13·7	41	43·5	74	64·2
8	14·5	42	44·4	75	64·0
9	15·3	43	45·3	76	63·7
10	16·2	44	46·2	77	63·4
11	17·0	45	47·1	78	63·1
12	17·9	46	48·1	79	62·7
13	18·7	47	49·0	80	62·3
14	19·5	48	50·0	81	61·9
15	20·4	49	51·0	82	61·5
16	21·2	50	51·9	83	61·0
17	22·1	51	52·9	84	60·4
18	23·0	52	53·8	85	59·8
19	23·8	53	54·8	86	59·2
20	24·7	54	55·7	87	58·5
21	25·6	55	56·7	88	57·7
22	26·4	56	57·7	89	57·0
23	27·3	57	58·7	90	56·2
24	28·1	58	59·7	91	55·3
25	29·0	59	60·7	92	54·3
26	29·9	60	61·7	93	53·3
27	30·8	61	62·7	94	52·2
28	31·7	62	63·7	95	51·0
29	32·6	63	64·8	96	49·6
30	33·5	63·5	65·4	97	48·0
31	34·4	64	65·4	98	46·3
32	35·3	65	65·3	99	44·5
33	36·2	66	65·2	100	42·6

(Mulder, Scheik. Verhandel. **1864**. 141.)

If solubility S=pts. anhydrous $FeSO_4$ in 100 pts. solution, S=13·5+0·3788t from −2° to +65°; S=37·5 constant from 65° to 98°; S=37·5−0·6685t from 98° to 156°. Practically insol. at 156°. (Étard, C. R. **106**. 740.)

Sp. gr. of $FeSO_4$+Aq at 15°.
%=% $FeSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·005	15	1·082	28	1·161
2	1·011	16	1·088	29	1·168
3	1·016	17	1·094	30	1·174
4	1·021	18	1·100	31	1·180
5	1·027	19	1·106	32	1·187
6	1·032	20	1·112	33	1·193
7	1·037	21	1·118	34	1·200
8	1·043	22	1·125	35	1·206
9	1·048	23	1·131	36	1·213
10	1·054	24	1·137	37	1·219
11	1·059	25	1·143	38	1·226
12	1·065	26	1·149	39	1·232
13	1·071	27	1·155	40	1·239
14	1·077	...	...	...	...

(Gerlach, Z. anal. **8**. 287.)

Sat. $FeSO_4$+Aq boils at 102·2° (Griffiths), and solution contains 64 % $FeSO_4$. Crust forms at 102·3°; highest temp. observed, 104·8°. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of $FeSO_4$+Aq containing pts. $FeSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $FeSO_4$	B.-pt.	Pts. $FeSO_4$
100·5°	17·7	101·5°	50·4
101·0	34·4	101·6	53·2

(Gerlach, Z. anal. **26**. 433.)

Sol. in hot HCl+Aq. (Kane.)

Somewhat sol. in conc. H_2SO_4. (Bussy and Lecann.)

More sol. in water containing NO than in pure H_2O. (Gay, Bull. Soc. (2) **44**. 175.)

Completely pptd. from $FeSO_4$+Aq by glacial $HC_2H_3O_2$. (Persoz.)

100 pts. sat. solution of $FeSO_4$ in 40 % alcohol contains 0·3 % $FeSO_4$. (Schiff.)

Insol. in alcohol of 0·905 sp. gr. or less. (Anthon, J. pr. **14**. 125.)

Alcohol and H_2SO_4 precipitate $FeSO_4$ from $FeSO_4$+Aq, also glacial acetic acid.

Anhydrous $FeSO_4$ is insol. in acetone. (Krug and M'Elroy, **1893**.)

Min. *Melanterite.*

Ferric sulphate, basic, $10Fe_2O_3, SO_3+H_2O$.

(Athanasesco, C. R. **103**. 27.)

$6Fe_2O_3, SO_3+10H_2O$. Insol. in H_2O. Sl. sol. in warm HCl+Aq. (Scheerer, Pogg. **45**. 188.)

$4Fe_2O_3, SO_3+11H_2O$. (Anthon, Repert. **81**. 237.)

$3Fe_2O_3, SO_3+4H_2O$. Insol. in H_2O. Rather easily sol. in acids. (Scheerer, Pogg. **44**. 453; Meister, B. **8**. 771.)

$2Fe_2O_3, SO_3+6H_2O$. When pptd. from cold solutions, is sol. in $Fe_2(SO_4)_3$+Aq, but insol. therein when pptd. from hot solutions. (Maus.)

Only basic sulphate which is a true chemical compound. (Pickering, Chem. Soc. **37**. 807.)

Min. *Glockerite.* Insol. in H_2O. Sol. in conc. H_2SO_4.

$+7H_2O$. (Meister.)

$+8H_2O$. (Mühlhauser.)

$+15H_2O$. Min. *Pissophanite.*

$Fe_2O_3, SO_3=(FeO)_2SO_4+3H_2O$. Insol. in H_2O. (Soubeiran, A. ch. **44**. 329.)

$3Fe_2O_3, 4SO_3+9H_2O$. (Athanasesco.)

$2Fe_2O_3, 3SO_3+8H_2O$. Insol. in H_2O. (Wittstein.)

$+18H_2O$. Min. *Fibroferrite.* Sl. sol. in cold, more easily in hot H_2O.

$Fe_2O_3, 2SO_3+10H_2O$. Min. *Stypticite.*

$+15H_2O$. Sol. in H_2O; decomp. by heat or evaporation. (Muck, J. pr. **99**. 103.)

$2Fe_2O_3, 5SO_3+13H_2O$. Min. *Copiapite.*

According to Pickering (Chem. Soc. **37**. 807), all basic ferric sulphates are mixtures excepting $2Fe_2O_3, SO_3$.

Ferric sulphate, $Fe_2(SO_4)_3$.

Anhydrous. Slowly deliquescent. Nearly insol. in H_2O, and $HCl+Aq$. Insol. in conc. H_2SO_4. Very rapidly sol. in $FeSO_4+Aq$, even when very dil. (Barreswil, C. R. **20**. 1366.)

Insol. in acetone.

$+xH_2O$. Very deliquescent, and sol. in H_2O. Conc. $Fe_2(SO_4)_3+Aq$ may be boiled without decomp., but dil. solutions are decomp. on heating. A solution containing 1 pt. salt to 100 pts. H_2O becomes turbid at 76°; 1 pt. to 200 pts., at 56°; 1 pt. to 400 pts., at 47°; 1 pt. to 800 pts., at 40°; 1 pt. to 1000 pts., at 38°; 1 pt. to 10,000 pts., at 14°. (Scheerer.)

Sp. gr. of $Fe_2(SO_4)_3+Aq$. According to F=Franz at 17·5° (J. pr. (2) **5**. 280); G=Gerlach at 15° (Z. anal. **28**. 494); H=Hager at 18° (Z. anal. **27**. 280).

	5	10	15	20 % $Fe_2(SO_4)_3$,
F	1·0426	1·0854	1·1324	1·1826
G	...	1·096	...	1·205
H	1·046	1·097	1·151	1·208

	25	30	35	40 % $Fe_2(SO_4)_3$,
F	1·2426	1·3090	1·3782	1·4506
G	...	1·331	...	1·478
H	1·271	1·337	1·411	1·490

	45	50	55	60 % $Fe_2(SO_4)_3$.
F	1·5298	1·6148	1·7050	1·8006
G	...	1·650	...	...

Completely pptd. from $Fe_2(SO_4)_3+Aq$ by $HC_2H_3O_2$. Sol. to large extent in alcohol.

$+9H_2O$. Min. *Coquimbite.*

$+10H_2O$. Slowly sol. in H_2O. (Oudemans, R. t. c. **3**. 331.)

Ferroferric sulphate, $6FeSO_4$, $Fe_2(SO_4)_3+60H_2O$.

Sol. in all proportions in H_2O. (Poumarède, C. R. **18**. 854.)

$3FeSO_4$, $2Fe_2(SO_4)_3+12H_2O$. Decomp. by H_2O. Easily sol. in dil. $HCl+Aq$. Insol. in alcohol. (Abich, **1842**.)

$FeSO_4$, $Fe_2(SO_4)_3+12H_2O$. Min. *Voltaite.* Difficultly sol. in H_2O.

FeO, Fe_2O_3, $6SO_3+15H_2O$. Deliquescent. (Lefort, J. Pharm. (4) **10**. 87.)

Ferroferric hydrogen sulphate, $Fe_2(SO_4)_3$, $FeSO_4$, $2H_2SO_4$.

Insol. in H_2O, but slowly decomp. thereby. Sol. in H_2SO_4. (Étard, C. R. **87**. 602.)

Ferrous *pyro*sulphate, FeS_2O_7.

Deliquescent. Decomp. by H_2O. (Bolas, Chem. Soc. (2) **12**. 212.)

Ferrous magnesium sulphate, $FeSO_4$, $MgSO_4+4H_2O$.

Sol. in H_2O. (Schiff.)

Ferric magnesium sulphate, $Fe_2(SO_4)_3$, $MgSO_4+24H_2O$.

(Bastick.)

Ferrous magnesium potassium sulphate, $2K_2SO_4$, $FeSO_4$, $MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ferric manganous hydrogen sulphate, $Fe_2(SO_4)_3$, $2MnSO_4$, H_2SO_4.

Insol. in cold H_2O. (Étard.)

$Fe_2(SO_4)_3$, $2MnSO_4$, $3H_2SO_4$. Sol. in H_2O. (Étard, C. R. **86**. 1399.)

Ferric manganic sulphate, $Fe_2(SO_4)_3$, $Mn_2(SO_4)_3$.

Insol. in cold H_2O; decomp. by hot H_2O and $HCl+Aq$. (Étard.)

Ferrous manganous potassium sulphate, $FeSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ferrous nickel sulphate, $2FeSO_4$, $2NiSO_4$, H_2SO_4.

(Étard, C. R. **87**. 602.)

Ferric nickel sulphate, $Fe_2(SO_4)_3$, $NiSO_4$, $2H_2SO_4$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87**. 602.)

Ferrous nickel potassium sulphate, $FeSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Ferrous potassium sulphate, $FeSO_4$, K_2SO_4.

$+2H_2O$. (Marignac, Ann. Min. (5) **9**. 19.)

$+6H_2O$. 100 pts. H_2O dissolve at t°:

0°	10°	14·5°	16°	25°
19·6	24·5	29·1	30·9	36·5 pts. anhydrous salt,

35°	40°	55°	65°	70°
41	45	56	59·3	64·2 pts. anhydrous salt.

(Tobler, A. **95**. 193.)

Ferric potassium sulphate, basic, $4Fe_2O_3$, K_2O, $5SO_3+9H_2O=4(Fe_2O_3, 2H_2O, SO_3)$, $K_2SO_4+7H_2O$.

Insol. in boiling H_2O. Sl. sol. in $HCl+Aq$, more readily in aqua regia. (Rammelsberg.)

$3Fe_2O_3$, K_2O, $4SO_3+6H_2O=K(FeO)_3(SO_4)_2+3H_2O$. Min. *Jarosite.*

Fe_2O_3, H_2O, $2SO_3$, $2K_2SO_4+5H_2O$. Sol. in 6 pts. cold H_2O. Solution soon decomposes. (Maus, Pogg. **11**. 78.)

Sol. in 12·5 pts. H_2O at 10°. (Anthon, Repert. **76**. 361.)

Formula is given as $3Fe_2O_3$, $5K_2O$, $12SO_3+18H_2O$ by Marignac.

$3Fe_2O_3$, $6SO_3$, $2K_2SO_4+22H_2O$. Sol. when moist in H_2O. Solution soon decomposes. Insol. in alcohol. (Soubeiran, A. ch. **44**. 329.)

$3Fe_2O_3$, $7SO_3$, $5K_2SO_4+12H_2O$, and $+17H_2O$. (Scheerer, Pogg. **87**. 81.)

$2Fe_2O_3$, $5SO_3$, $3K_2SO_4+9H_2O$. (S.)

$3Fe_2O_3$, $8SO_3$, $4K_2SO_4+20H_2O$, and $24H_2O$. (S.)

Ferric potassium sulphate, K_2SO_4, $2Fe_2(SO_4)_3$.

Insol. in H_2O, but is gradually decomp. thereby. (Grimm and Ramdohr, A. **98**. 127.)

$K_2Fe_2(SO_4)_4+24H_2O$. *Iron alum.*

Sol. in 5 pts. H_2O at 12·5°. (Anthon.)

Aqueous solution is decomp. by heating. Insol. in alcohol.

Sp. gr. of aqueous solution. According to G=Gerlach, at 15° (Z. anal. **28.** 496); F=Franz, at 17·5° (J. pr. (2) **5.** 288), containing:

	5	10	15 % $K_2Fe_2(SO_4)_4+24H_2O$,
F	1·0268	1·0466	1·0672
G	1·025	1·0507	1·0773
	20	25	30 % $K_2Fe_2(SO_4)_4+24H_2O$,
F	1·0894	1·1136	1·1422
G	1·1050	1·1340	1·1645
			35 % $K_2Fe_2(SO_4)_4+24H_2O$.
G			1·1967.

$Fe_2(SO_4)_3$, $3K_2SO_4$. Insol. in H_2O, but slowly decomp. thereby. (Étard, C. R. **84.** 1089.)

Ferrous potassium zinc sulphate, $FeSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O.

Ferrous rubidium sulphate, $FeSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

Ferrous sodium sulphate, $FeSO_4$, $Na_2SO_4+4H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **9.** 25.)

Ferric sodium sulphate, basic, $4Fe_2O_3$, Na_2O, $5SO_3+9H_2O$.

Insol. in H_2O; difficultly sol. in $HCl+Aq$. (Scheerer, Pogg. **45.** 190.)

Fe_2O_3, $2Na_2O$, $4SO_3+8H_2O$. Min. *Urusite.* Insol. in H_2O; easily sol. in $HCl+Aq$.

Ferrous thallium sulphate, $FeSO_4$, $Tl_2SO_4+6H_2O$.

Easily decomp. by solution in H_2O. (Willm, A. ch. (4) **5.** 56.)

Ferric thallium sulphate, $Tl_2Fe_2(SO_4)_4+24H_2O$.

Not efflorescent. Very easily sol. in H_2O.

Ferrous zinc sulphate, $FeSO_4$, $ZnSO_4+14H_2O$.

Sol. in H_2O.

$2FeSO_4$, $2ZnSO_4$, H_2SO_4. (Étard, C. R. **87.** 602.)

Ferric zinc sulphate, $Fe_2(SO_4)_3$, $ZnSO_4+24H_2O$.

(Bastick.)

Lanthanum sulphate, basic, $2La_2O_3$, $3SO_3+3H_2O$.

Precipitate. (Frerichs and Smith.)

Formula is $3La_2O_3$, SO_3+xH_2O. (Cleve, B. **11.** 910.)

Lanthanum sulphate, $La_2(SO_4)_3$.

Anhydrous. Much less sol. in warm than in cold H_2O. 1 pt. is sol. in less than 6 pts. H_2O, if added in small portions thereto at 2-3°, and the temperature not allowed to rise to 13°; but if heated to 30°, $La_2(SO_4)_3+9H_2O$ separates out until the solution is solid. (Mosander.)

$+9H_2O$. Sol. in 42·5 pts. H_2O, calculated as anhydrous salt, at 23°, and 115 pts. H_2O at 100°. (Mosander.)

Less sol. in neutral, and more sol. in acid solutions than $Di_2(SO_4)_3$. (Watts, Chem. Soc. **2.** 145.)

Lanthanum potassium sulphate, $La_2(SO_4)_3$, $3K_2SO_4$.

Sl. sol. in H_2O. Insol. in sat. K_2SO_4+Aq. (Cleve.)

$La_2(SO_4)_3$, $4K_2SO_4$. As above. (Cleve.)

$2La_2(SO_4)_3$, $9K_2SO_4$. As above. (Cleve.)

Lanthanum sodium sulphate, $La_2(SO_4)_3$, $Na_2SO_4+2H_2O$.

Sl. sol. in H_2O. (Cleve.)

Lead sulphate, basic, $2PbO$, SO_3.

Not completely insol. in H_2O. Decomp. by acids, even dil. $HC_2H_3O_2+Aq$, with formation of $PbSO_4$. (Barfoed, **1869.**)

Min. *Lanarkite.*

$5PbO$, $3SO_3$. (Frankland, Proc. Roy. Soc. **46.** 364.)

Pb_3O_4, $2SO_3$. (Frankland.)

Lead sulphate, $PbSO_4$.

Sol. in 22,816 pts. H_2O at 11°. (Fresenius, A. **59.** 125.)

Sol. in 31,569 pts. H_2O at 15°. (Rodwell, C. N. **11.** 50.)

Sol. in 13,000 pts. H_2O. (Kremers, Pogg. **85.** 247.)

Calculated from electrical conductivity of $PbSO_4+Aq$, 1 l. H_2O dissolves 46 mg. $PbSO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Sol. in 36,504 pts. dil. H_2SO_4+Aq. (Fresenius.) See also under solubility in alcohol.

Sl. sol. in conc. H_2SO_4, from which it is partially pptd. by H_2O or completely by alcohol. (Fresenius.)

100 pts. conc. H_2SO_4 dissolve 6 pts. $PbSO_4$. (Schultz, Pogg. **133.** 137.)

Conc. H_2SO_4 dissolves 0·005 pt. $PbSO_4$. (Ure.)

More sol. in commercial H_2SO_4 than in the more conc. acid. (Hayes.)

100 pts. H_2SO_4+Aq of 1·841 sp. gr. dissolve 0·039 pt. $PbSO_4$; of 1·793 sp. gr. dissolve 0·011 pt. $PbSO_4$; of 1·540 sp. gr. dissolve 0·003 pt. $PbSO_4$.

Presence of SO_2 does not increase the solubility; HNO_3 increases the solubility somewhat, *i.e.*, 100 pts. H_2SO_4+Aq of 1·841 sp. gr. with 5 pts. HNO_3 of 1·352 sp. gr. dissolve 0·044 pt. $PbSO_4$; 100 pts. H_2SO_4 of 1·749 sp. gr. with 5 pts. HNO_3 of 1·352 sp. gr. dissolve 0·014 pt. $PbSO_4$; 100 pts. H_2SO_4 of 1·512 sp. gr. with 5 pts. HNO_3 of 1·352 sp. gr. dissolve only a trace.

Nitrous oxides do not increase the action. (Kolb, Dingl. **209.** 268.)

Pptd. from solution in H_2SO_4 by HCl. (Bolley, A. **91.** 113.)

Sol. in hot conc. $HCl+Aq$. (Fresenius.)

Solubility of $PbSO_4$ in $HCl+Aq$.

Sp. gr. of $HCl+Aq$	% HCl in $HCl+Aq$	Pts. $HCl+Aq$ for 1 pt. $PbSO_4$
1·0519	10·602	681·89
1·0800	16·310	281·73
1·1070	22·010	105·65
1·1359	27·525	47·30
1·1570	31·602	35·03

(Rodwell, Chem. Soc. **15.** 59.)

Sol. in HNO_3+Aq, and more sol. in hot or conc. than in cold or dil. HNO_3+Aq.

Sol. in 172 pts. HNO_3+Aq of 1·144 sp. gr. at 12·5° (Bischof.)

Pptd. from HNO_3 solution by dil. H_2SO_4+Aq and not by H_2O. (Bischof, **1827.**)

Solubility of $PbSO_4$ in HNO_3+Aq.

Sp. gr. of HNO_3+Aq	% HNO_3 in HNO_3+Aq	Pts. HNO_3+Aq for 1 pt. $PbSO_4$
1·079	11·55	303·10
1·123	17·50	173·75
1·250	34·00	127·48
1·420	60·00	10282·78

(Rodwell, Chem. Soc. **15.** 59.)

Not more insol. in dil. $HC_2H_3O_2+Aq$ than in H_2O. (Bischof.)

Solubility in other acids is prevented by great excess of H_2SO_4. (Wackenroder.)

Sol. in warm NH_4OH+Aq, separating on cooling. Completely sol. in warm KOH or $NaOH+Aq$.

Decomp. by boiling with K_2CO_3, Na_2CO_3, and $(NH_4)_2CO_3+Aq$.

Sol. in NH_4 salts $+Aq$, but repptd. by H_2SO_4+Aq. (Fresenius, A. **59.** 125.)

The best solvents of the NH_4 salts are the nitrate, citrate, and tartrate; the two latter should be strongly alkaline with NH_4OH+Aq. (Wackenroder.)

Sol. in NH_4Cl+Aq at 12·5-25°.

Sol. in 47 pts. $NH_4C_2H_3O_2+Aq$ (1·036 sp. gr.), and 969 pts. NH_4NO_3+Aq (1·269 sp. gr.); from the solution in $NH_4C_2H_3O_2$ it is pptd. by H_2SO_4 or K_2SO_4; from solution in NH_4NO_3 by K_2SO_4, but not by H_2SO_4. (Bischof.)

Sol. in $(NH_4)_2SO_4+Aq$. (Rose.)

Sol. in acetates of NH_4, Na, K, Ca, Al, and Mg. (Mercer.)

Very easily and abundantly sol. in NH_4 tartrate $+Aq$. (Wöhler, A. **34.** 235.)

Even when native, easily sol. in NH_4 citrate $+Aq$. (Smith.)

Sl. decomp. by $NaCl+Aq$. (Bley.)

1 l. sat. $NaCl+Aq$ dissolves 0·66 g. $PbSO_4$. (Becquerel.)

Sol. in 100 pts. cold conc. $NaCl+Aq$, and $PbCl_2$ is deposited after a few hours. (Field.)

Sol. in $Na_2S_2O_3+Aq$. (Löwe.)

Sol. in Fe_2Cl_6+Aq. (Fresenius, Z. anal. **19.** 419.)

100 pts. H_2O containing a drop of $HC_2H_3O_2$ and 2·05 pts. $NaC_2H_3O_2$ dissolve 0·054 pt. $PbSO_4$; containing 8·2 pts. $NaC_2H_3O_2$ dissolve 0·900 pt. $PbSO_4$; containing 41·0 pts. $NaC_2H_3O_2$ dissolve 11·200 pts. $PbSO_4$.

Sol. in $Mn(C_2H_3O_2)_2$, $Zn(C_2H_3O_2)_2$, $Ni(C_2H_3O_2)_2$, and $Cu(C_2H_3O_2)_2$, but not in $Hg(C_2H_3O_2)_2$ or $AgC_2H_3O_2+Aq$.

Solubility in $KC_2H_3O_2+Aq$ is not less than that in $NaC_2H_3O_2+Aq$. (Dibbits, Z. anal. **13.** 137.)

Insol. in $Pb(C_2H_3O_2)_2+Aq$. (Smith.)

Sol. in basic lead acetate $+Aq$, but not in neutral $Pb(C_2H_3O_2)_2+Aq$. (Stammer, Z. anal. **23.** 67.)

12·2 pts. $Ca(C_2H_3O_2)_2$ in very dil. solution dissolve 1 pt. $PbSO_4$. (Städel, Z. anal. **2.** 180.)

Sol. in $Al(C_2H_3O_2)_3+Aq$. (Lennsen.)

Insol. in alcohol (18 %) and H_2SO_4 when NH_4 acetate, K tartrate, or NH_4 succinate are present. Insol. in alcohol (18 %) and H_2SO_4 or $(NH_4)_2SO_4$ when Na acetate, Na or NH_4 oxalate are present. Sol. in NH_4 *di*citrate and K *tri*citrate in presence of H_2SO_4; in NH_4 succinate and NH_4 acetate in presence of $(NH_4)_2SO_4$; and in NH_4 citrate in presence of H_2SO_4 or $(NH_4)_2SO_4$. (Storer, C. N. **21.** 17.)

Alcohol (59 %) alone, or with ethylsulphuric acid or sugar, does not dissolve Pb by 3 months action. (Storer.)

Min. *Anglesite.* Sol. in cold citric acid $+Aq$. (Bolton, C. N. **37.** 14.)

Lead sulphate, acid, $PbSO_4$, $H_2SO_4+H_2O$.

Decomp. by H_2O.

100 pts. boiling H_2SO_4 dissolve 6 pts. $PbSO_4$. (Schultz, Pogg. **133.** 137.)

100 pts. H_2SO_4 dissolve 0·13 pt. $PbSO_4$, and 100 pts. fuming H_2SO_4 dissolve 4·19 pts. (Struve, Z. anal. **9.** 31.)

Lead *pyro*sulphate, PbS_2O_7.

Decomp. by H_2O. (Schultz.)

Lead sulphate chloride, $PbSO_4$, $2PbCl_2+H_2O$.

Insol. in H_2O or $NaCl+Aq$. (Becquerel, C. R. **20.** 1523.)

Lead sulphate fluoride, $PbSO_4$, $2PbF_2$.

Not decomp. by H_2SO_4. (Lonyet, C. R. **24** 434.)

Lithium sulphate, Li_2SO_4.

More sol. in cold than in hot H_2O.

100 pts. H_2O dissolve 34·6 pts. Li_2SO_4 at 18°. (Wittstein.)

100 pts. H_2O dissolve pts. Li_2SO_4 at t°.

t°	Pts. Li_2SO_4	t°	Pts. Li_2SO_4	t°	Pts. Li_2SO_4
0	35·34	45	32·38	100	29·24
20	34·36	65	30·3	...	...

(Kremers, Pogg **95**

Sat. solution boils at 105°. (Kremers.)

If solubility S = pts. Li_2SO_4 in 100 pts. solution, S = 18·5 + 0·8421t from −20° to −10·5°; S = 26·5 − 0·0274t from −10·5° to 100°. (Étard, C. R. **106.** 741.)

Sp. gr. of Li_2SO_4+Aq at 19·5° containing:

6·5	7·4	12·5	15·3 % Li_2SO_4,
1·05	1·06	1·098	1·118

22·6	24·4	29·4 % Li_2SO_4.
1·167	1·178	1·208

(Kremers, Pogg. **114.** **47.**)

Sp. gr. of Li_2SO_4+Aq at 15° containing 5 % Li_2SO_4 = 1·0430; 10 % Li_2SO_4 = 1·0877. (Kohlrausch, W. Ann. **1879.** 1.)

Insol. in SO_3. (Weber, B. **17.** 2497.)

Easily sol. (Kastner), sl. sol. (Berzelius) in alcohol.

$+H_2O$. Very sl. efflorescent. (Rammelsberg.)

Lithium hydrogen sulphate, $LiHSO_4$.

Decomp. by H_2O.

Cryst. from H_2SO_4. (Gmelin.)

$LiH_3(SO_4)_2$. Cryst. from H_2SO_4. (Schultz, Pogg. **133.** 137.)

Lithium potassium sulphate, $LiKSO_4$.

(Rammelsberg.)

$K_4Li_2(SO_4)_3$. (Knobloch.) Has the formula $K_2Li_8(SO_4)_5+8H_2O$, according to Rammelsberg.

Lithium sodium sulphate, $Na_3Li(SO_4)_2+6H_2O$.

$Na_4Li_2(SO_4)_3+9H_2O$.

$Na_2Li_8(SO_4)_5+5H_2O$. (Rammelsberg.)

Do not exist. (Troost.)

Magnesium sulphate, $MgSO_4$.

Anhydrous. Very slowly sol. in H_2O; sol. in hot conc. H_2SO_4, less in HCl, and HNO_3+Aq.

$+H_2O$. Min. *Kieserite.* Easily sol. in warm, but slowly dissolved by cold H_2O.

$+6H_2O$, and $+7H_2O$. The latter exists in two modifications; (*a*) hexagonal, and (*b*) the ordinary or rhombic salt.

$MgSO_4+Aq$, which on cooling or keeping in closed vessels has deposited $MgSO_4+6H_2O$, always contains for 100 pts. H_2O at:

0°	10°	20°
40·75	42·23	43·87 pts. $MgSO_4$.

If only hexagonal $MgSO_4+7H_2O$ has been deposited, then the mother liquor contains for 100 pts. H_2O at:

0°	10°	20°
34·67	38·71	42·84 pts. $MgSO_4$.

Solutions prepared from rhombic $MgSO_4+7H_2O$ contain for 100 pts. H_2O at:

0°	10°	20°
26·0	30·9	35·6 pts. $MgSO_4$.

(Löwel.)

These results may be given in tabular form as follows:

Temp.	A sat. aqueous solution of $MgSO_4+7H_2O$ (*b*) contains for 100 pts. H_2O	
	Anhydrous $MgSO_4$	$7H_2O$ (*b*) salt
0°	26·0	73·31
10°	30·9	93·75
20°	35·6	116·54

Temp.	A sat. aqueous solution of $MgSO_4+7H_2O$ (*a*) contains for 100 pts. H_2O	
	Anhydrous $MgSO_4$	$7H_2O$ (*a*) salt
0°	34·67	111·74
10°	38·71	133·67
20°	42·84	159·61

Temp.	A sat. aqueous solution of $MgSO_4+6H_2O$ contains for 100 pts. H_2O		
	Anhydrous $MgSO_4$	$6H_2O$ salt	$7H_2O$ salt
0°	40·75	122·22	146·02
10°	42·23	129·44	155·53
20°	43·87	137·72	167·97

It is seen from table that at the same temp. the $6H_2O$ salt is more sol. than the $7H_2O$ (*b*) salt, and the latter is more sol. than $7H_2O$ (*a*) salt; that the solubility of the $7H_2O$ (*b*) salt increases rapidly from 0° to 20°; that the $6H_2O$ salt is not much more sol. at 20° than at 0°; and at 20° the $7H_2O$ (*b*) salt is nearly as sol. as the $6H_2O$ salt. (Löwel, A. ch. (3) **43.** 405.)

100 pts. H_2O at t° dissolve pts. $MgSO_4$. G L = according to Gay-Lussac (A. ch. (2) **11.** 311); T = according to Tobler (A. **95.** 198).

t°	G L	T	t°	G L	T
0	25·8	24·7	50	49·7	..
10	30·5	..	55	..	52·8
20	35·0	..	60	55·9	..
25	..	37·1	70	60·4	..
30	39·8	..	80	65·1	..
40	45·2	..	90	70·3	..

100 pts. H_2O at 105·5° dissolve 135·2 pts. $MgSO_4$. (Griffiths.)

$MgSO_4+Aq$ sat. at 17·5° has sp. gr. = 1·2932, and contains 55·57 % $MgSO_4+7H_2O$, or 100 pts. H_2O dissolve 125·06 pts. $MgSO_4+7H_2O$, or 60 pts. $MgSO_4$, at 17·5°. (Karsten.)

100 pts. H_2O at 0° dissolve 58·8 pts., and 125 pts. at ord. temp. (Otto-Graham.)

Sol. in 2 pts. cold, and 0·5 pt. boiling H_2O. (Fourcroy.)

The aqueous solution contains for 100 pts. H_2O 92·217 pts. $MgSO_4+7H_2O$ at 15°. (Michel and Krafft.)

1 pt. $MgSO_4+7H_2O$ is sol. in 0·933 pt. H_2O at 15° (Gerlach); in 0·92 pt. H_2O at 23° (Schiff).

100 pts. H_2O dissolve 28·067 pts. $MgSO_4$ at 0°. (Pfaff, A. **99.** 224.)

100 pts. H_2O dissolve pts. $MgSO_4$ at t°.

t°	Pts. $MgSO_4$
0	26·37
17·9	33·28
24·1	35·98

(Diacon, J. B. **1866.** 62.)

100 pts. $MgSO_4+Aq$ sat. at 18-20° contain 25·67-26·38 pts. $MgSO_4$. (v. Hauer, J. pr. **98.** 137.)

Solubility in 100 pts. H_2O at t°, using $MgSO_4+7H_2O$.

t°	Pts. $MgSO_4$	t°	Pts. $MgSO_4$	t°	Pts. $MgSO_4$
0	26·9	37	44·2	74	61·4
1	27·4	38	44·7	75	61·9
2	27·9	39	45·2	76	62·3
3	28·3	40	45·6	77	62·8
4	28·8	41	46·1	78	63·2
5	29·3	42	46·5	79	63·7
6	29·7	43	47·0	80	64·2
7	30·2	44	47·5	81	64·6
8	30·6	45	48·0	82	65·1
9	31·1	46	48·4	83	65·6
10	31·5	47	48·9	84	66·0
11	32·0	48	49·3	85	66·5
12	32·4	49	49·8	86	67·0
13	32·9	50	50·3	87	67·5
14	33·4	51	50·7	88	68·0
15	33·8	52	51·2	89	68·4
16	34·3	53	51·7	90	68·9
17	34·7	54	52·2	91	69·4
18	35·2	55	52·7	92	69·9
19	35·7	56	53·2	93	70·4
20	36·2	57	53·6	94	70·9
21	36·7	58	54·1	95	71·4
22	37·1	59	54·5	96	71·9
23	37·6	60	55·0	97	72·4
24	38·0	61	55·5	98	72·8
25	38·5	62	55·9	99	73·3
26	39·0	63	56·4	100	73·8
27	39·5	64	56·8	101	74·3
28	39·9	65	57·3	102	74·8
29	40·4	66	57·7	103	75·2
30	40·9	67	58·2	104	75·7
31	41·4	68	58·6	105	76·2
32	41·8	69	59·1	106	76·7
33	42·3	70	59·6	107	77·2
34	42·8	71	60·0	108	77·7
35	43·3	72	60·5	108·4	77·9
36	43·7	73	61·0	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 52.)

100 pts. H_2O dissolve 72·4 pts. $MgSO_4+7H_2O$ at 0°; 178 pts. at 40°; and 212·6 pts. at 49°. (Tilden, Chem. Soc. **45.** 409.)

If solubility S=pts. anhydrous salt in 100 pts. solution, S=20·5+0·2276t from 0° to 123°; S=48·5−0·4403t from 123° to 190°. (Étard, C. R. **106.** 741.)

Supersat. $MgSO_4+Aq$ is brought to crystallisation by addition of crystal of $MgSO_4+7H_2O$, or an isomorphous substance as $ZnSO_4+7H_2O$, $NiSO_4+7H_2O$, $FeSO_4+7H_2O$, or $CoSO_4+7H_2O$. (Thomson, Chem. Soc. **35.** 199.)

$MgSO_4+Aq$ with sp. gr. 1·50 contains 44·4 % $MgSO_4$; sp. gr. 1·42, 39 %; sp. gr. 1·30, 30 % $MgSO_4$. (Dalton.)

Sp. gr. of $MgSO_4+Aq$ sat. at 15°=1·275 (Michel and Krafft); at 8°=1·267 (Anthon); at 18·75°=1·293 (Karsten).

Sp. gr. of $MgSO_4+Aq$ at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1·054	30	1·326
10	1·108	35	1·384
15	1·161	40	1·446
20	1·215	45	1·511
25	1·269	50	1·580

(Calculated from Anthon by Schiff, A. **107.** 303.)

Sp. gr. of $MgSO_4+Aq$ at 23°.

% $MgSO_4$ $+7H_2O$	Sp. gr.	% $MgSO_4$ $+7H_2O$	Sp. gr.
1	1·0048	28	1·1426
2	1·0096	29	1·1481
3	1·0144	30	1·1536
4	1·0193	31	1·1592
5	1·0242	32	1·1648
6	1·0290	33	1·1704
7	1·0339	34	1·1760
8	1·0387	35	1·1817
9	1·0437	36	1·1875
10	1·0487	37	1·1933
11	1·0537	38	1·1991
12	1·0587	39	1·2049
13	1·0637	40	1·2108
14	1·0688	41	1·2168
15	1·0739	42	1·2228
16	1·0790	43	1·2288
17	1·0842	44	1·2349
18	1·0894	45	1·2410
19	1·0945	46	1·2472
20	1·0997	47	1·2534
21	1·1050	48	1·2596
22	1·1103	49	1·2659
23	1·1156	50	1·2722
24	1·1209	51	1·2786
25	1·1262	52	1·2850
26	1·1316	53	1·2915
27	1·1371	54	1·2980

(Schiff, A. **113.** 185.)

Sp. gr. of $MgSO_4+Aq$ at 12°.

% $MgSO_4+7H_2O$	Sp. gr.	% $MgSO_4+7H_2O$	Sp. gr.
1	1·0046	21	1·1071
2	1·0096	22	1·1125
3	1·0146	23	1·1179
4	1·0196	24	1·1234
5	1·0246	25	1·1289
6	1·0296	26	1·1344
7	1·0346	27	1·1399
8	1·0396	28	1·1454
9	1·0446	29	1·1510
10	1·0497	30	1·1566
11	1·0548	31	1·1622
12	1·0599	32	1·1679
13	1·0650	33	1·1736
14	1·0702	34	1·1793
15	1·0754	35	1·1850
16	1·0807	36	1·1908
17	1·0859	37	1·1965
18	1·0911	38	1·2023
19	1·0964	39	1·2082
20	1·1018	40	1·2140

(Oudemans, Z. anal. **7.** 419.)

Sp. gr. of $MgSO_4+Aq$ at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
1	1·01031	14	1·15083
2	1·02062	15	1·16222
3	1·03092	16	1·17420
4	1·04123	17	1·18618
5	1·05154	18	1·19816
6	1·06229	19	1·21014
7	1·07304	20	1·22212
8	1·08379	21	1·23465
9	1·09454	22	1·24718
10	1·10529	23	1·25972
11	1·11668	24	1·27225
12	1·12806	25	1·28478
13	1·13945	25·248	1·28802

(Gerlach, Z. anal. **8.** 287.)

Sp. gr. of $MgSO_4+Aq$ at 23·5°. a=no. of $\frac{1}{2}$ mols. in grms. dissolved in 1000 g. H_2O; b=sp. gr. if a is $MgSO_4+7H_2O$, $\frac{1}{2}$ mol. wt.=123; c=sp. gr. if a is $MgSO_4$, $\frac{1}{2}$ mol. wt.=60.

a	b	c	a	b	c
1	1·056	1·059	5	1·203	1·260
2	1·103	1·114	6	1·229	...
3	1·141	1·166	7	1·252	...
4	1·174	1·214	8	1·273	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $MgSO_4+Aq$ at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1·0510	20	1·2200
10	1·1052	25	1·2861
15	1·1602	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $MgSO_4+Aq$ at 0°. S=pts. $MgSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
13·800	1·1586	7·4046	1·0826
11·7458	1·1329	5·0447	1·0557
9·6218	1·1072	2·5907	1·0284

(Charpy, A. ch. (6) **29.** 26.)

Sat. $MgSO_4+Aq$ boils at 105° (Griffiths); 108·4° (Mulder).

Crust forms at 103·5° (solution containing 48·4 pts. $MgSO_4$ to 100 pts. H_2O); highest temp. observed, 105°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $MgSO_4+Aq$ containing pts. $MgSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $MgSO_4$	B.-pt.	Pts. $MgSO_4$	B.-pt.	Pts. $MgSO_4$
100·5°	8·8	102·5°	34·7	104·5°	51·3
101·0	16·7	103·0	39·5	105	54·6
101·5	23·5	103·5	43·8	108	75 (?)
102·0	29·5	104·0	47·7	...	...

(Gerlach Z. anal. **26.** 432.)

M.-pt. of $MgSO_4+7H_2O$ is 70°. (Tilden, Chem. Soc. **45.** 409.)

Completely pptd. from $MgSO_4+Aq$ by conc. $HC_2H_3O_2+Aq$. (Persoz.)

More sol. in $HCl+Aq$ than in H_2O. (Richter.)

In sat. $HCl+Aq$ anhydrous $MgSO_4$ is scarcely sol.; $MgSO_4+7H_2O$ dissolves, but is precipitated by a current of HCl gas. (Hensgen, B. **10.** 259.)

Margueritte (C. R. **43.** 50) denies the precipitation.

Rapidly sol. in sat. $CuSO_4+Aq$; when saturation is reached, a double salt separates out. (Karsten.)

Slowly sol. in sat. $ZnSO_4+Aq$ without pptn. until saturation, when a double salt separates out.

Sol. in sat. $NaCl+Aq$ without pptn. of the latter.

Rapidly sol. in $KCl+Aq$ with separation of K_2SO_4.

Somewhat sol. in sat. NH_4Cl+Aq with separation of a double sulphate.

Easily sol. in sat. KNO_3+Aq without causing any pptn.

Sol. in sat. $NaNO_3+Aq$. (Karsten.)

100 pts. H_2O dissolve 25·95 pts. $MgSO_4$ and 5·21 pts. Na_2SO_4 at 0°. (Diacon, J. B. **1866.** 62.)

100 pts. H_2O dissolve 15·306 pts. $MgSO_4$ and 13·086 pts. Na_2SO_4 at 0°. (Pfaff, A. **99.** 224.)

100 pts. sat. $MgSO_4+NiSO_4+Aq$ at 18-20° contain 30·93 pts. of the two salts; 100 pts. sat. $MgSO_4+ZnSO_4+Aq$ at 18-20° contain 35·45 pts.; 100 pts. sat. $MgSO_4+NiSO_4+ZnSO_4+Aq$ at 18-20° contain 35·62 pts. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O dissolve 14·1 pts. $MgSO_4$ and

9·8 pts. K_2SO_4, if sat. $MgSO_4+Aq$ is sat. with K_2SO_4; 32·4 pts. $MgSO_4$ and 8·2 pts. K_2SO_4, if sat. K_2SO_4+Aq is sat. with $MgSO_4$, all at 15°. (Mulder, J. B. **1866**.)

100 pts. dil. alcohol containing:

	10	20	40 % alcohol
contain at 15°,	39·3	21·3	1·62 % $MgSO_4+7H_2O$.

(Schiff, A. **118**. 365.)

At higher temp. the solubility increases proportional to the temp. (Gerardin, A. ch. (4) **5**. 145.)

100 pts. absolute methyl alcohol dissolve 1·18 pts. $MgSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10**. 783.)

100 pts. absolute methyl alcohol dissolve 41 pts. $MgSO_4+7H_2O$ at 17°; 100 pts. absolute methyl alcohol dissolve 29 pts. $MgSO_4+7H_2O$ at 3-4°; 100 pts. 93 % methyl alcohol dissolve 9·7 pts. $MgSO+7H_2O$ at 17°; 100 pts. 50 % methyl alcohol dissolve 4·1 pts. $MgSO_4+7H_2O$ at 3-4°. (de Bruyn, R. t. c. **11**. 112.)

100 pts. absolute ethyl alcohol dissolve 1·3 pts. $MgSO_4+7H_2O$ at 3°. (de Bruyn.)

Magnesium hydrogen sulphate, $MgH_2(SO_4)_2$.

Decomp. by H_2O. Sol. in H_2SO_4.

$MgH_6(SO_4)_4$. Boiling H_2SO_4 dissolves about 2 % $MgSO_4$, from which this compound crystallises. (Schultz, Pogg. **133**. 137.)

Magnesium *pyro*sulphate, MgS_2O_7.

Decomp. by H_2O.

Magnesium manganous sulphate, $MgSO_4$, $2MnSO_4+15H_2O$.

Min. *Fauserite.*

Magnesium manganous zinc sulphate, $MgSO_4$, $MnSO_4$, $ZnSO_4+21H_2O$.

Sol. in H_2O. (Vohl, A. **99**. 124.)

Magnesium nickel sulphate, $MgSO_4$, $3NiSO_4+28H_2O$.

Sol. in H_2O. (Schiff.)

Magnesium nickel potassium sulphate, $MgSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Magnesium potassium sulphate, $MgK_2(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 22·7 pts. anhydrous salt at 16·5°. (Mulder.)

100 pts. H_2O dissolve at:

0°	10°	20°	30°	35°	
14·1	19·6	25·0	30·4	33·2	pts. anhydrous salt,
45°	55°	60°	65°	75°	
40·5	47·0	50·2	53·0	59·8	pts. anhydrous salt.

(Tobler, A. **95**. 193.)

Sp. gr. of aqueous solution at 15° containing:

2	4	6	8 % hydrous salt,
1·0129	1·0261	1·0394	1·053
10	12	14	16 % hydrous salt,
1·0668	1·0808	1·095	1·1094
18	20	22 % hydrous salt.	
1·124	1·1388	1·1539	

(Schiff, A. **113**. 183, calculated by Gerlach, Z. anal. **8**. 287.)

Min. *Picromerite.*

$+4H_2O$. (van der Heide, B. **26**. 414.)

Magnesium potassium zinc sulphate, $MgSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Magnesium potassium sulphate chloride, $MgSO_4$, K_2SO_4, $MgCl_2+6H_2O$.

Min. *Kainite.*

Magnesium rubidium sulphate, $MgSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63**. 337.)

Magnesium sodium sulphate, $MgSO_4$, $Na_2SO_4+4H_2O$.

Min. *Blödite, Simonyite.*

Blödite is efflorescent; Simonyite deliquescent.

$+5H_2O$. Min. *Löwite.*

$+6H_2O$. Decomp. on air. Sol. in 3 pts. cold H_2O.

Magnesium thallous sulphate, $MgSO_4$, $Tl_2SO_4+6H_2O$.

Sol. in H_2O, but decomp. by repeated recrystallisations. (Werther.)

Magnesium zinc sulphate, $MgSO_4$, $ZnSO_4+14H_2O$.

Sol. in H_2O. (Pierre, A. ch. (3) **16**. 244.)

$+10H_2O$. (Pierre.)

$3ZnSO_4$, $5MgSO_4+56H_2O$. (Schiff.)

Magnesium sulphate potassium chloride, $MgSO_4$, $KCl+3H_2O$ or $MgSO_4$, K_2SO_4, $MgCl_2+6H_2O$.

Min. *Kainite.*

100 pts. H_2O dissolve 79·56 pts. at 18°. (Krause, Arch. Pharm. (3) **6**. 326.)

Not sol. in a mixture of abs. alcohol and ether, which dissolves out $MgCl_2$. (Lehmann, J. B. **1867**. 416.)

Alcohol dissolves out $MgCl_2$, also little H_2O. Much H_2O dissolves completely. (Zincken, Miner. Jahrb. **1865**. 310.)

Magnesium sulphate potassium chromate, $2MgSO_4$, $K_2CrO_4+9H_2O$.

Sol. in H_2O. (Étard, C. R. **85**. 443.)

Manganous sulphate, basic, $3MnO$, $2SO_3+3H_2O$.

Insol. in H_2O, but slowly decomp. thereby. (Gorgeu, C. R. **94**. 1425.)

Manganous sulphate, $MnSO_4$.

Anhydrous.

Absorbs H_2O from the air to form $MnSO_4+4H_2O$.

1 pt. $MnSO_4$ is sol. in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
6·25	1·77	18·75	1·667	75	1·494
10	1·631	37·5	1·457	101·25	2·031

Or—

100 pts. H_2O dissolve pts. $MnSO_4$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
6·25	56·49	18·75	60·00	75	66·95
10	61·29	37·5	68·63	101·25	49·33

(Brandes, Pogg. **20.** 575.)

Sol. in 2·5 pts. H_2O at 18·75°; at 62·5° it is difficult to dissolve 1 pt. $MnSO_4$ in 3 pts. H_2O, but the sat. solution at 62·5° does not become cloudy on heating to 100°. (Jahn.)

100 pts. $MnSO_4$+Aq sat. at 11-14° contain 37·5 pts. $MnSO_4$. (v. Hauer, J. pr. **103.** 114.)

Solubility in H_2O increases from 0-55°, and decreases from 55-145°. The increasing solubility is that of $MnSO_4+5H_2O$, and $MnSO_4+2H_2O$ separates out at 35°, and is completely insol. at 145°. (Étard.)

If solubility S=pts. anhydrous $MnSO_4$ in 100 pts. solution, $S=30·0+0·2828t$ from −8° to 57°; $S=48·0-0·4585t$ from 57° to 150°.

Practically insol. in H_2O at 180°. (Étard, C. R. **106.** 208.)

Solubility varies according to the hydrate used. Above results of Étard show the solubility of $MnSO_4+7H_2O$ at 0°, and $MnSO_4+3H_2O$ at 57°. Anhydrous $MnSO_4$ is stable only above 117°. (Linebarger.)

100 pts. H_2O dissolve pts. anhydrous $MnSO_4$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
120	67·18	141	41·18	155	26·49
132	63·16	146	38·83	170	16·15

(Linebarger, Am. Ch. J. **15.** 225.)

$+H_2O$. Stable only between 57° and 117°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
48	87·98	78	79·13	115	69·78
53	86·10	90	75·63	117	68·81
65	84·33	100	71·27	...	...
72	82·73	106	70·14	...	...

(Linebarger.)

Min. *Szmikite.*

$+2H_2O$. Stable between 40° and 57°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+2H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
35	68·88	42	77·63	50	83·16
40	75·31	45	80·07	55	86·27

(Linebarger.)

$+3H_2O$. Stable between 30° and 40°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+3H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
5	54·68	25	66·85	48	71·89
12	60·56	30	67·38	53	72·81
16	63·41	35	68·31	57	73·17
19	65·12	40	70·63	...	...

(Linebarger.)

$+4H_2O$. Sl. efflorescent. Less sol. in boiling than in cold H_2O.

100 pts. H_2O at 4·4° dissolve 31 pts. $MnSO_4+4H_2O$. (Jahn.)

100 pts. H_2O at t° dissolve pts. $MnSO_4+4H_2O$.

t°	Pts. $MnSO_4+4H_2O$	t°	Pts. $MnSO_4+4H_2O$
6·25	113·22	37·5	149
10	123	75	144
18·75	122	101·25	93

(Brandes, Pogg. **20.** 575.)

Solubility of $MnSO_4$ in 100 pts. H_2O at t°, using $MnSO_4+4H_2O$.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
0	55·4	35	71·9	70	61·5
1	55·9	36	72·2	71	61·5
2	56·5	37	72·4	72	61·5
3	57·1	38	72·7	73	61·5
4	57·7	39	72·9	74	61·5
5	58·2	40	73·1	75	61·5
6	58·8	41	73·3	76	61·5
7	59·4	42	73·5	77	61·5
8	60·0	43	73·7	78	61·5
9	60·5	44	73·9	79	61·5
10	61·1	45	74·0	80	61·5
11	61·7	46	74·2	81	61·5
12	62·2	47	74·4	82	61·5
13	62·7	48	74·6	83	61·5
14	63·3	49	74·7	84	61·4
15	63·8	50	74·8	85	61·3
16	64·3	51	74·9	86	61·2
17	64·8	52	75·1	87	61·0
18	65·3	53	75·2	88	60·8
19	65·8	54	75·3	89	60·6
20	66·3	55	74·7	90	60·3
21	66·7	56	74·0	91	60·0
22	67·2	57	72·9	92	59·6
23	67·6	58	71·5	93	59·2
24	68·1	59	69·5	94	58·6
25	68·5	60	65·9	95	57·9
26	68·9	...	...	96	57·2
27	69·3	63·5	61·3	97	56·3
28	69·7	64	61·5	98	55·4
29	70·0	65	61·5	99	54·3
30	70·4	66	61·5	100	52·9
31	70·7	67	61·5	101	51·2
32	71·0	68	61·5	102	49·3
33	71·3	69	61·5	102·5	47·4
34	71·6	...	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 137.)

Stable between 18° and 30°

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+4H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
2·2	57·88	25	72·23	48	84·33
7·3	61·78	30	74·67	52	86·16
11	64·01	35·5	78·81	56	88·19
15	67·12	40	79·63	...	...
20	69·93	45	83·06	...	...

(Linebarger.)

$+5H_2O$. Sol. in 1 pt. H_2O at 18·75°. (Jahn, A. **28.** 110.)
Stable from 8° to 18°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+5H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	t° $MnSO_4$
0	58·05	20	75·16	40	84·63
2·5	62·41	25	78·63	42	85·27
4	64·22	30	79·16	45	86·16
7	66·83	32	80·38	47·7	86·95
10	68·05	34	82·04	53	88·89
15	72·33	37	83·91	54	89·08

(Linebarger.)

$+6H_2O$. Stable from −5° to +8°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+6H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
−4	55·87	9	70·88	30	76·24
0	64·21	15	72·45	34	77·02
3	66·87	20	74·35	35	77·23
5	67·49	25	75·38	38	78·41

(Linebarger.)

$+7H_2O$. Efflorescent.
Sol. in less than 0·5 pt. H_2O at 18·75°. (Jahn.)
Stable between −10° and −5°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+7H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
−10	50·11	0	53·61	10	59·91
−8	50·93	5	54·83	15	64·34
−5	51·53	7	56·62	...	...

(Linebarger.)

M.-pt. of $MnSO_4+7H_2O$ is 54°. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of $MnSO_4$+Aq at 15°.

% $MnSO_4$ $+4H_2O$	Sp. gr.	% $MnSO_4$ $+4H_2O$	Sp. gr.
1	1·006	29	1·208
2	1·013	30	1·2150
3	1·020	31	1·224
4	1·025	32	1·231
5	1·0320	33	1·244
6	1·038	34	1·250
7	1·044	35	1·2579
8	1·050	36	1·268
9	1·056	37	1·276
10	1·0650	38	1·285
11	1·072	39	1·295
12	1·079	40	1·3038
13	1·085	41	1·313
14	1·093	42	1·322
15	1·1001	43	1·331
16	1·106	44	1·340
17	1·114	45	1·3495
18	1·121	46	1·360
19	1·129	47	1·370
20	1·1363	48	1·380
21	1·144	49	1·389
22	1·150	50	1·3986
23	1·160	51	1·410
24	1·166	52	1·420
25	1·1751	53	1·430
26	1·183	54	1·440
27	1·190	55	1·4514
28	1·200	...	...

(Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $MnSO_4$+Aq at 23°. a=no. of ½ mols. in grms. dissolved in 1000 g. H_2O; b=sp. gr. if a is $MnSO_4+5H_2O$, ½ mol. wt.=120·5; c=sp. gr. if a is $MnSO_4$, ½ mol. wt.=75·5.

a	b	c	a	b	c
1	1·068	1·071	6	1·306	1·376
2	1·128	1·139	7	1·341	1·429
3	1·181	1·202	8	1·371	...
4	1·227	1·262	9	1·399	...
5	1·269	1·320	10	1·426	...

(Favre and Valson, C. R. **79.** 968.)

Above table recalculated by Gerlach (Z. anal. **28.** 475.)

% $MnSO_4$ $+5H_2O$	Sp. gr.	% $MnSO_4$ $+5H_2O$	Sp. gr.
10	1·0630	40	1·2900
20	1·1325	50	1·3800
30	1·2070	...	...

Sp. gr. of $MnSO_4$+Aq at 15°. a=%; b=sp. gr. if a is $MnSO_4$; c=sp. gr. if a is $MnSO_4+4H_2O$; d=sp. gr. if a is $MnSO_4+5H_2O$; e=sp. gr. if a is $MnSO_4+7H_2O$.

a	b	c	d	e
5	1·0500	1·0340	1·0310	1·0270
10	1·1035	1·0690	1·0630	1·0545
15	1·1605	1·1055	1·0965	1·0830
20	1·2215	1·1435	1·1315	1·1130
25	1·2870	1·1835	1·1685	1·1440
30	1·3575	1·2255	1·2070	1·1765
35	...	1·2695	1·2470	1·2105
40	...	1·3155	1·2885	1·2455
45	...	1·3640	1·3315	1·2815
50	...	...	1·3760	1·3185
55	...	...	...	1·3565

(Gerlach, Z. anal. **28**. 475.)

Sp. gr. of $MnSO_4$+Aq at 0°. S=pts. $MnSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
16·7450	1·1834	8·8295	1·0928
14·0462	1·1519	6·0172	1·0622
11·5804	1·1239	3·0865	1·0315

(Charpy, A. ch. (6) **29**. 26.)

Sat. $MnSO_4$+Aq boils at 102·4°; crust forms at 101·6°, and solution contains 48·7 pts. $MnSO_4$ to 100 pts. H_2O.

B.-pt. of $MnSO_4$+Aq containing pts. $MnSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $MnSO_4$	B.-pt.	Pts. $MnSO_4$
100·5°	17·1	102·0°	58·9
101·0	32·1	102·4	68·4
101·5	46·2	...	...

(Gerlach, Z. anal. **26**. 434.)

Sol. in about 20 pts. boiling H_2SO_4, and more sol. in boiling H_2SO_4+Aq of 1·6 sp. gr. (Schultz, Pogg. **133**. 137.)

$MnSO_4$+Aq sat. at 10°, then sat. with K_2SO_4 at same temp. contains for 100 pts. H_2O 16·7 pts. $MnSO_4$ and 44·3 pts. K_2SO_4. (Mulder.)

Completely pptd. from solution by $HC_2H_3O_2$. (Persoz.)

Anhydrous $MnSO_4$ is insol. in absolute alcohol.

1000 pts. alcohol of 0·872 sp. gr. dissolve 6·3 pts. $MnSO_4$.

Insol. in absolute ether or boiling oil of turpentine.

Sol. in 50 pts. of 50 % alcohol. Insol. in absolute alcohol. (Brandes, Pogg. **20**. 556.)

100 pts. solution saturated at 15° in dil. alcohol containing:

0	10	50	60	% alcohol, contain
56·25	51·4	2·0	0·66	pts. $MnSO_4+5H_2O$.

(Schiff, A. **118**. 365.)

Insol. in absolute ether between 5° and 7°, and no crystal H_2O is removed thereby. Insol. in boiling oil of turpentine, but 1 mol. crystal H_2O is removed from $MnSO_4+4H_2O$. (Brandes, Pogg. **20**. 568.)

When $MnSO_4+7H_2O$ is boiled with absolute alcohol none is dissolved, but $MnSO_4+3H_2O$ is formed.

When $MnSO_4+7H_2O$ is dissolved in 15-50 % alcohol, the liquid separates into two layers, the lower containing less (12-14 %) alcohol and more (47-49 %) salt; the upper containing more (50-55%) alcohol and less (1·3-2·2 %) salt. If the alcohol has the above strength (15-50 %) the separation takes place at ordinary temp., but with 13-14 % or 60 % or more alcohol, warming is necessary to effect the separation. (Schiff, A. **118**. 363.)

$MnSO_4+7H_2O$ occurs as the min. *Mallardite.*

Manganomanganic sulphate, $MnO, MnO_2, 4SO_3+9H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in little dil. H_2SO_4+Aq. (Fremy, C. R. **82**. 475.)

Manganous hydrogen sulphate.

$MnSO_4$ is sol. in 20 pts. boiling conc. H_2SO_4; more sol. in boiling H_2SO_4+Aq of 1·6 sp. gr. (Schultz.)

$MnH_2(SO_4)_2$, and $+H_2O$. Sol. in H_2O with decomp. (Schultz.)

$MnH_6(SO_4)_4$. Sol. in H_2O with decomp. (Schultz.)

Manganic sulphate, $Mn_2(SO_4)_3$.

Extremely deliquescent. Sol. in H_2O with evolution of heat, and decomposition into a basic sulphate. Behaves similarly with dilute acids. Sol. in traces in cold conc. H_2SO_4. Insol. in cold conc. HNO_3+Aq. Sol. in conc. HCl+Aq. Decomp. by absolute alcohol. (Carius, A. **98**. 53.)

Manganic hydrogen sulphate, $Mn_2H_2(SO_4)_4+8H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in dil. H_2SO_4+Aq. (Francke, J. pr. (2) **36**. 251.)

Manganous nickel potassium sulphate, $MnSO_4, NiSO_4, 2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 57.)

Manganous potassium sulphate, $K_2SO_4, MnSO_4+2H_2O$.

$+4H_2O$. Efflorescent. (Pierre, A. ch. (3) **16**. 239.)

Manganic potassium sulphate, $K_2Mn_2(SO_4)_4+24H_2O$.

Decomp. by dissolving in H_2O. (Mitscherlich.)

Manganomanganic potassium sulphate, $Mn_3(SO_4)_3, 5K_2SO_4=3Mn(SO_4)_2, 2MnSO_4, 5K_2SO_4$.

Decomp. by much H_2O. Sol. in dil. or conc. H_2SO_4. Insol. in alcohol or ether. (Francke, J. pr. (2) **36**. 166.)

Manganous potassium zinc sulphate, $MnSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Manganous rubidium sulphate, $MnSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63**. 337.)

Manganous sodium sulphate, $MnSO_4$, Na_2SO_4.

$+2H_2O$. Deliquescent in moist air. (Geiger.)

$+4H_2O$. Sol. in 1·2 pts. boiling H_2O. (Geiger.)

Manganous sulphate ammonia, $MnSO_4$, $4NH_3$.

Decomp. by H_2O. (Rose, Pogg. **20**. 148.)

Mercurous sulphate, Hg_2SO_4.

Sol. in 500 pts. cold, and 300 pts. hot H_2O. Easily sol. in dil. HNO_3+Aq, from which solution it is separated by dil. H_2SO_4+Aq. (Wackenroder, A. **41**. 319.)

Abundantly sol. in hot, less sol. in cold dil. H_2SO_4+Aq. (Berzelius.)

Partially decomp. by hot NH_4 salts+Aq. (Miahle, A. ch. (3) **5**. 179.)

Mercuric sulphate, basic, $3HgO$, SO_3.

(*Mineral turpeth*).

Sol. in 2000 pts. cold, and 600 pts. boiling H_2O. (Fourcroy, A. ch. **10**. 307.)

Sol. in 43,478 pts. H_2O at 16° when pptd. cold, and in 32,258 pts. at 16° when pptd. at 100°. (Cameron, Z. anal. **19**. 144.)

Sl. sol. in warm dil. H_2SO_4+Aq. (Rose.)

Sol. in warm conc. HCl or HBr+Aq. (Ditte.)

Sol. in alkali chlorides+Aq. (Miahle.)

$4HgO$, $3SO_3$. (Hopkins, Sill. Am. J. **18**. 364.)

$4HgO$, SO_3. (Athanasesco, C. R. **103**. 271.)

Mercuric sulphate, $HgSO_4$.

Decomp. by H_2O into $3HgO$, SO_3, and a sol. acid salt. Sol. in dil. H_2SO_4+Aq. Decomp. by all acids. (Berzelius.)

Sol. in warm conc. HCl or HBr+Aq; very sl. sol. in boiling conc. HI+Aq. (Ditte, A. ch. (5) **17**. 124.)

Sol. with decomp. in NaCl+Aq. (Miahle.)

Insol. in conc. alcohol.

$+H_2O$. Decomp. by H_2O. (Eisfeldt, Pharm. Centr. **1853**. 812.)

Mercuric sulphate, acid, $HgH_2(SO_4)_2$.

(Braham, C. N. **42**. 163.)

Mercuromercuric sulphate, Hg_2O, $2HgO$, SO_3.

Insol. in cold H_2O; not decomp. by boiling H_2O. Decomp. by HCl+Aq. (Brooke, Pogg. **66**. 63.)

Mercuric potassium sulphate, $3HgSO_4$, $K_2SO_4+2H_2O$.

Sol. in H_2O. (Hirzel, J. B. **1850**. 332.)

Mercuric sulphate chloride ammonium chloride, $2HgSO_4$, $HgCl_2$, $2NH_4Cl$.

Decomp. with H_2O. Ether dissolves out $HgCl_2$. (Kosmann, A. ch. (3) **27**. 238.)

Mercuric sulphate hydrobromide, $HgSO_4$, $2HBr$.

Sol. in H_2O without separation of basic sulphate. (Ditte, A. ch. (5) **17**. 122.)

$3HgO$, SO_3, $6HBr$. Sol. in H_2O. (Ditte.)

Mercuric sulphate hydrochloride, $HgSO_4$, $2HCl$.

Sol. in H_2O without separation of a basic salt. Very sol. in warm H_2SO_4, solidifying on cooling if very conc., or crystallising if dil. (Ditte.)

$3HgO$, SO_3, $6HCl$. Sol. in H_2O. (Ditte.)

Mercuric sulphate iodide, $HgSO_4$, HgI_2.

Decomp. by H_2O, not by alcohol or ether. (Riegel, J. B. pr. Pharm. **11**. 396.)

Mercuric sulphate phosphide.

See ***Di*****mercuriphosphonium mercuric sulphate.**

Mercuric sulphate sulphide, $2HgSO_4$, HgS.

Sl. sol. in hot HCl, H_2SO_4, or HNO_3+Aq. Easily sol. in hot aqua regia. (Jacobson, Pogg. **68**. 410.)

$2HgSO_4$, HgS. (Palm, C. C. **1863**. 122.)

$HgSO_4$, $2HgS$. (Barfoed, J. B. **1864**. 282.)

$HgSO_4$, $3HgS$. Insol. in H_2O. Easily sol. in aqua regia; decomp. by HNO_3 into—

$3HgSO_4$, HgS. Insol. in all acids except aqua regia. (Spring, A. **199**. 116.)

Molybdenum *sesqui*sulphate (?).

Basic. Insol. in H_2O.

Neutral. Decomp. by H_2O into acid and basic salts.

Acid. Sol. in H_2O. (Berzelius.)

Molybdenum *di*sulphate (?).

Sol. in H_2O.

Molybdic sulphate, MoO_3, SO_3.

Deliquescent. Sol. in H_2O. (Schultz-Sellack, B. **4**. 14.)

MoO_3, $3SO_3+2H_2O$. Deliquescent. Partially sol. in H_2O. (Anderson, Berz. J. B. **22**. 161.)

Does not exist. (Schultz-Sellack.)

Nickel sulphate, basic.

Very sl. sol. in H_2O. (Berzelius.)

$6NiO$, $5SO_3+4H_2O$. (Athanasesco, C. R. **103**. 271.)

$7NiO$, $7H_2O$, SO_3+3H_2O. Nearly insol. in H_2O. (Habermann, M. **5**. 432.)

Nickel sulphate, $NiSO_4$, and $+H_2O$, $2H_2O$, $6H_2O$, and $7H_2O$.

100 pts. H_2O dissolve pts. $NiSO_4$ at t°:

2°	16°	20°	23°	31°
30·4	37·4	39·7	41	45·3 pts. $NiSO_4$,

41°	50°	53°	60°	70°
49·1	52	54·4	57·2	61·9 pts. $NiSO_4$.

(Tobler, A. **95**. 193.)

100 pts. of sat. solution contain: at 11-14°, 28·84; at 18-20°, 30·77 pts. anhydrous salt. (v. Hauer, W. A. B. **53**, 2. 221.)

100 pts. H_2O at 112·5° dissolve 185·71 pts. $NiSO_4$. (Griffiths.)

$NiSO_4+7H_2O$ is sol. in 3 pts. H_2O at 12·5°. (Tupputi.)

100 pts. H_2O at 15·5° dissolve 75·6 pts. $NiSO_4+7H_2O$.

Solubility in 100 pts. H_2O at t°, using $NiSO_4+7H_2O$.

t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$
0	29·3	37	47·5	74	68·2
1	29·7	38	48·0	75	68·8
2	30·1	39	48·5	76	69·3
3	30·5	40	49·0	77	69·9
4	31·0	41	49·6	78	70·5
5	31·5	42	50·1	79	71·1
6	32·0	43	50·6	80	71·7
7	32·5	44	51·2	81	72·3
8	33·0	45	51·7	82	72·9
9	33·5	46	52·3	83	73·5
10	34·0	47	52·8	84	74·1
11	34·5	48	53·4	85	74·6
12	35·0	49	53·9	86	75·2
13	35·5	50	54·5	87	75·8
14	36·0	51	55·0	88	76·4
15	36·5	52	55·6	89	77·0
16	37·0	53	56·1	90	77·6
17	37·5	54	56·7	91	78·2
18	38·0	55	57·3	92	78·8
19	38·5	56	57·9	93	79·4
20	39·0	57	58·4	94	80·1
21	39·5	58	59·0	95	80·7
22	40·0	59	59·6	96	81·3
23	40·5	60	60·2	97	81·9
24	41·0	61	60·7	98	82·5
25	41·5	62	61·3	99	83·1
26	42·0	63	61·9	100	83·7
27	42·5	64	62·4	101	84·3
28	43·0	65	63·0	102	84·9
29	43·5	66	63·6	103	85·6
30	44·0	67	64·1	104	86·2
31	44·5	68	64·7	105	86·8
32	45·0	69	65·3	106	87·5
33	45·5	70	65·9	107	88·1
34	46·0	71	66·5	108	88·7
35	46·5	72	67·0	108·4	88·7
36	47·0	73	67·6	...	...

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. **1864**. 70.)

M.-pt. of $NiSO_4+7H_2O$=98-100°. (Tilden, Chem. Soc. **45**. 409.)

Sp. gr. of $NiSO_4$+Aq containing g. $NiSO_4+7H_2O$ in 1000 g. H_2O at 23·5°.

140·5 g. (=½ mol.)	281	421·5	562
1·073	1·136	1·190	1·238

602·5	843	983·5	1124
1·280	1·317	1·349	1·378

Containing $NiSO_4$ (anhydrous):

77·5 g. (=½ mol.)	155	232·5	310	387·5	465
1·079	1·153	1·224	1·292	1·358	1·421

(Gerlach, Z. anal. **28**. 468.)

Sp. gr. of $NiSO_4$+Aq at 0°. S=pts. $NiSO_4$ in 100 pts. solution; S_1=mols. $NiSO_4$ in 100 mols. solution.

S	S_1	Sp. gr.
4·2930	0·581	1·0522
3·9591	0·476	1·0431
3·2845	0·392	1·0357
2·5043	0·297	1·0271
1·6131	0·189	1·0173
0·8327	0·097	1·0089

(Charpy, A. ch. (6) **29**. 26.)

$HC_2H_3O_2$ precipitates it completely from aqueous solution. (Persoz.)

100 pts. sat. $NiSO_4+ZnSO_4$+Aq at 18-20° contain 35·45 pts. of the two salts. (v. Hauer.)

Insol. in alcohol and ether.

100 pts. absolute methyl alcohol dissolve 0·5 pt. $NiSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10**. 783.)

100 pts. absolute methyl alcohol dissolve 46 pts. $NiSO_4+7H_2O$ at 17°; 100 pts. absolute methyl alcohol dissolve 24·7 pts. $NiSO_4+7H_2O$ at 4°; 100 pts. 93·5 % methyl alcohol dissolve 10·1 pts. $NiSO_4+7H_2O$ at 4°; 100 pts. 50 % methyl alcohol dissolve 2 pts. $NiSO_4+7H_2O$ at 4°.

100 pts. absolute ethyl alcohol dissolve 1·3 pts. $NiSO_4+7H_2O$ at 4°.

100 pts. absolute methyl alcohol dissolve 31·6 pts. $NiSO_4+6H_2O$ at 17°; 100 pts. 93·5 % methyl alcohol dissolve 7·8 pts. $NiSO_4+6H_2O$ at 18°; 100 pts. 50 % methyl alcohol dissolve 1·9 pts. $NiSO_4+6H_2O$ at 18°. (de Bruyn, Z. phys. Ch. **10**. 786.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Min. *Morenosite.*

Nickel potassium sulphate, $NiSO_4$, $K_2SO_4+6H_2O$.

Sol. in 8-9 pts. H_2O. (Tupputi.)

100 pts. H_2O dissolve at:

0°	10°	14°	20°	30°	
5·3	8·9	10·5	13·8	18·6	pts. anhydrous salt,
36°	49°	55°	60°	75°	
20·4	27·7	32·4	35·4	45·6	pts. anhydrous salt.

(Tobler, A. **95**. 193.)

Saturated solution contains at:

20°	40°	60°	80°	
8·7	12·3	17·6	22·0	% anhydrous salt.

(v. Hauer, J. pr. **74**. 433.)

Nickel potassium zinc sulphate, $NiSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94**. 51.)

Nickel rubidium sulphate, $NiSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63**. 337.)

Nickel thallium sulphate, $NiSO_4$, $Tl_2SO_4+6H_2O$.

Easily sol. in H_2O. Can be recryst. from little H_2O without decomp. (Werther, J. pr. **92**. 132.)

Nickel zinc sulphate, $NiSO_4$, $ZnSO_4 + 13H_2O$.
Sol. in 3-4 pts. cold H_2O. Insol. in alcohol. (Tupputi, **1811.**)

Completely sol. in $NH_4OH + Aq$.

$2NiSO_4$, $2ZnSO_4$, H_2SO_4. (Etard, C. R. **87.** 602.)

Nickel sulphate ammonia, $NiSO_4$, $6NH_3$.

Sol. in H_2O with separation of hydroxide. (Rose, Pogg. **20.** 151.)

$NiSO_4$, $5NH_3 + 3\frac{1}{2}H_2O$. Deliquescent. (André, C. R. **106.** 936.)

$NiSO_4$, $4NH_3 + 2H_2O$. Easily sol. in H_2O. Can be recrystallised out of little H_2O. Insol. even in dil. alcohol. (Erdmann.)

Nitrosyl sulphate, $H(NO)SO_4$.
See **Nitrosulphonic acid.**

Osmious sulphate.
Easily sol. in H_2O and alcohol.

Osmic sulphate.
Sol. in H_2O. (Berzelius.)

Palladious sulphate, basic, $PdSO_4$, $7PdO + 6H_2O$, and $10H_2O$.
Insol. in H_2O. Easily sol. in $HCl + Aq$. (Kane.)

Palladious sulphate, $PdSO_4 + 2H_2O$.
Deliquescent in moist air; very sol. in H_2O, but decomp. by much H_2O, with separation of a basic salt. (Kane.)

Phosphoryl sulphate, $(PO)_2(SO_4)_3$ (?).
Possible composition of Weber's (B. **20.** 86) P_2O_5, $3SO_3$ (?).

Platinic sulphate, $Pt(SO_4)_2$.
Deliquescent. Sol. in H_2O, alcohol, or ether; also in H_3PO_4, HCl, and $HNO_3 + Aq$. (Berzelius.)

$PtSO_4(OH)_2$, $4Pt(OH)_4 + 3H_2O$. Ppt. (Prost, Bull. Soc. (2) **46.** 156.)

$Pt_8(SO_4)O_{13} + 16H_2O$. As above. (Prost.)

Platinic potassium sulphate, basic.
Insol. in boiling H_2O, HNO_3, H_2SO_4, H_3PO_4, $HC_2H_3O_2$, or $NH_4OH + Aq$. Easily sol. in boiling $HCl + Aq$. Sl. decomp. by aqua regia. (E. Davy.)

$Pt_{10}(SO_4)_2O_{10}$, $3K_2SO_4 + 34H_2O$. Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

$Pt_{18}(SO_4)O_{22}$, $5K_2SO_4 + 34H_2O$. As above. (Prost.)

Platinum rubidium sulphate, $Pt_6Rb_6(SO_4)_4 + 17H_2O$.
Sol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Potassium sulphate, K_2SO_4.
Not hygroscopic in the ordinary sense of the word. 100 pts. K_2SO_4 over H_2O at 14-20° absorb 58 pts. H_2O in 22 days, and finally deliquesce completely. (Mulder.)

12 pts. K_2SO_4 mixed with 100 pts. H_2O lower the temp. 3·3°. (Rüdorff, B. **2.** 68.)

100 pts. H_2O dissolve with absorption of heat at 0°:

8·36	pts K_2SO_4.	(Gay-Lussac.)
8·46	,,	(Mulder.)
8·5	,,	(Gerardin.)
7·31	,,	(Möller, Pogg. **117.** 386.)
7·3-7·9	,,	(Nordenskiöld, Pogg. **136.** 314.)

100 pts. H_2O at 0° dissolve 8·36 pts. K_2SO_4; at 12·72°, 10·57 pts.; at 49·08°, 16·91 pts.; at 63·90°, 19·29 pts.; at 101·50°, 26·33 pts. (Gay-Lussac, A. ch. (2) **11.** 311.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
0	7·8	47·0	16·0
15·65	10·3	70·2	20·3
28·1	12·8	98·0	23·9

(Nordenskiöld, Pogg. **136.** 314.)

100 pts. sat. K_2SO_4 at 101·7° contain 17·5 pts. K_2SO_4, or 100 pts. H_2O at 101·25° dissolve 21·212 pts. K_2SO_4. (Griffiths.)

100 pts. H_2O at 102·8° dissolve 29 pts. K_2SO_4 (Penny); at 15°, 7·3-6·25 pts. (Ure's Dict.); at 100°, 20 pts. (Ure's Dict.); at 100°, 24·2 pts. (Wenzel).

Sol. in 9·081 pts. H_2O at 15° (Gerlach); in 16 pts. at 15° and 5 pts. at 100° (Bergmann); in 18 pts. cold, and 4 pts. boiling H_2O (Fourcroy); in 15 pts. cold, and 5 pts. boiling H_2O (Reid); in 12 pts. H_2O at 0° and 4 pts. boiling H_2O (M. R. and P.); in 12 pts. H_2O at 18·75° (Abl).

K_2SO_4 sat. at 15° has sp. gr. = 1·0774, and contains 10·055 pts. K_2SO_4 in 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve 9·26 pts. K_2SO_4 at 15·6°, and sat. solution has sp. gr. = 1·177. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
0	8·5	35	13·1	70	19·8
1	8·6	36	13·3	71	20·0
2	8·7	37	13·4	72	20·2
3	8·8	38	13·6	73	20·4
4	9·0	39	13·8	74	20·6
5	9·1	40	14·0	75	20·8
6	9·2	41	14·2	76	21·0
7	9·3	42	14·3	77	21·2
8	9·4	43	14·5	78	21·4
9	9·5	44	14·7	79	21·6
10	9·7	45	14·9	80	21·8
11	9·8	46	15·1	81	22·0
12	9·9	47	15·3	82	22·2
13	10·0	48	15·5	83	22·4
14	10·2	49	15·6	84	22·6
15	10·3	50	15·8	85	22·8
16	10·4	51	16·0	86	23·0
17	10·5	52	16·2	87	23·2
18	10·7	53	16·4	88	23·4
19	10·8	54	16·6	89	23·6
20	10·9	55	16·8	90	23·9
21	11·1	56	17·0	91	24·1
22	11·2	57	17·2	92	24·3
23	11·3	58	17·4	93	24·5
24	11·5	59	17·6	94	24·7
25	11·6	60	17·8	95	25·0
26	11·7	61	18·0	96	25·2
27	11·9	62	18·2	97	25·5
28	12·0	63	18·4	98	25·7
29	12·2	64	18·6	99	25·9
30	12·3	65	18·8	100	26·2
31	12·5	66	19·0	101	26·4
32	12·6	67	19·2	102	26·6
33	12·8	68	19·4	102·25	26·75
34	13·0	69	19·6	...	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. **1864.** 50.)

If solubility S=pts. anhydrous salt in 100 pts. of solution, S=7·5+0·1070t from 0° to 163°. Solubility from 163° to 220° is constant at 25. (Etard, C. R. **106**. 208.)

Solubility of K_2SO_4 in 100 pts. H_2O at high temp.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
16	9·76	39	14·21	120	26·5
20	10·30	54	17·39	143	28·8
28	12·59	98	23·91	170	32·9
36	13·28	...	...	...	...

(Tilden and Shenstone, Phil. Trans. **1884**. 23.)

Solubility of K_2SO_4 in H_2O. 100 pts. H_2O dissolve at:

4·3°	18·4°	69·9°
8·16	10·8	19·7 pts. K_2SO_4.

(Andreae, J. pr. (2) **29**. 456.)

100 ccm. H_2O dissolve 12·04 g. K_2SO_4 at 25°. (Trevor, Z. phys. Ch. **7**. 468.)

Solubility of K_2SO_4 in H_2O at various pressures. Figures denote pts. K_2SO_4 contained in 100 pts. sat. K_2SO_4+Aq at t° and A pressure in atmospheres.

A	0°	15°	15·5°	16·2°
1	6·81	9·14	9·24	9·35
20	7·14	...	9·44	9·54
30	7·14	...	...	...

(Möller, Pogg. **117**. 386.)

Sp. gr. of K_2SO_4 at 19·5°.

% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.
2·401	1·0193	9·264	1·0763
4·744	1·0385	10·945	1·0909
6·968	1·0568	..	..

(Kremers, Pogg. **95**. 120.)

Sp. gr. and b.-pt. of K_2SO_4+Aq at 12·5°.

Pts. K_2SO_4 to 100 pts. H_2O	Sp. gr.	B.-pt.	Pts. K_2SO_4 to 100 pts. H_2O	Sp. gr.	B.-pt.
1	1·0079	100·38°	6	1·0456	101·12°
2	1·0151	100·63°	7	1·0524	101·25°
3	1·0231	100·75°	8	1·0599	101·25°
4	1·0305	100·88°	9	1·0676	101·38°
5	1·0391	101°	10	1·0735	101·5°

(Brandes and Gruner, **1827**.)

K_2SO_4+Aq sat. at 8° has 1·072 sp. gr. (Anthon, A. **24**. 211.)

K_2SO_4+Aq saturated at 12° contains 10·38 % K_2SO_4 and has sp. gr. 1·0716 (Struve, Zeit. Ch. (2) **5**. 323); saturated at 15° contains 11·01 % K_2SO_4 and has sp. gr. 1·0831 (Gerlach); saturated at 18·75° contains 10·74 % K_2SO_4 and has sp. gr. 1·0798 (Karsten).

Sp. gr. of K_2SO_4+Aq at 15°.

% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.
1	1·0082	5	1·0410	8	1·0664
2	1·0163	6	1·0495	9	1·0750
3	1·0245	7	1·0579	9·92	1·0830
4	1·0328	...	...	...	...

(Gerlach, Z. anal. **8**. 287.)

Sp. gr. of K_2SO_4+Aq at 18°.

% K_2SO_4	Sp. gr.
5	1·0395
10	1·0815

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of K_2SO_4+Aq at 15°/15°. a=pts. K_2SO_4 in 100 pts. of the solution; b=pts. K_2SO_4 in 100 pts. H_2O.

a	b	Sp. gr.
1	1·010	1·00808
3	3·093	1·02447
5	5·263	1·04091
7	7·527	1·05776
9	9·890	1·07499
9·92	11·013	1·08305

(Gerlach, Z. anal. **28**. 493.)

Sp. gr. of K_2SO_4+Aq at 20° containing 0·5 mol. K_2SO_4 to 100 mols. H_2O=1·03758; containing 1 mol. K_2SO_4 to 100 mols. H_2O=1·06744. (Nicol, Phil. Mag. (5) **16**. 122.)

Sat. K_2SO_4+Aq boils at 101·5°, and contains 26·33 pts. K_2SO_4 to 100 pts. H_2O (Gay-Lussac); at 101·7°, and contains 21·2 pts. K_2SO_4 to 100 pts. H_2O (Griffiths); at 102·25°, and contains 26·75 pts. K_2SO_4 to 100 pts. H_2O (Mulder); boils at 103° (Kremers).

Crust forms at 101·7°, and solution contains 25·3 pts. K_2SO_4 to 100 pts. H_2O; highest temp. observed, 102·1°. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of K_2SO_4+Aq containing pts. K_2SO_4 to 100 pts. H_2O.

B.-pt.	Pts. K_2SO_4	B.-pt.	Pts. K_2SO_4
100·5°	7	102°	30·0
101·0	14·5	102·1	31·6
101·5	22·1	...	...

(Gerlach, Z. anal. **26**. 430.)

Sol. in conc. acids; not pptd. by glacial $HC_2H_3O_2$. Insol. in KOH+Aq of 1·35 sp. gr. (Liebig, A. **11**. 262.)

Pptd. from K_2SO_4+Aq by NH_4OH+Aq. (Sullivan.)

Difficultly sol. in 20 % $KC_2H_3O_2$+Aq. (Stromeyer.)

Solubility of K_2SO_4 in NH_4OH + Aq.

Wt. NH_3 in 100 ccm. H_2O	Wt. K_2SO_4 in 100 ccm. H_2O
0 g.	10·804 g.
6·08 g.	4·100 g.
15·37 g.	0·828 g.
24·69 g.	0·140 g.
31·02 g.	0·042 g.

(Girard, Bull. Soc. (2) **43.** 522.)

More sol. in aqueous solutions of other salts, as Na_2SO_4, $MgSO_4$, $CuSO_4$, etc., than in pure H_2O. (Pfaff, A. **99.** 227.)

Sol. in sat. Na_2SO_4 + Aq, $MgSO_4$ + Aq, NaCl + Aq. (*See* $MgSO_4$ and NaCl.)

Sl. sol. in sat. $ZnSO_4$ or $CuSO_4$ + Aq with separation of double salt.

Sl. sol. in sat. KCl + Aq without pptn. (*See* KCl.)

Sol. in sat. NH_4Cl + Aq without pptn. (*See* NH_4Cl.)

Sl. sol. in sat. KNO_3 + Aq without causing pptn. (*See* KNO_3.)

Sol. in sat. $NaNO_3$ + Aq without causing pptn. at first, but soon KNO_3 is pptd. (Karsten.) (*See* $NaNO_3$.)

Sol. in $(NH_4)_2SO_4$ + Aq with pptn. of $(NH_4)_2SO_4$. (Rüdorff, B. **6.** 485.)

100 pts. H_2O dissolve 8·5 + 0·12t pts. K_2SO_4. On addition of a K salt, K_2SO_4 is pptd. The amount of K_2SO_4 remaining in solution plus the amt. of K in the salt added is a constant. (Blarez, C. R. **112.** 939.)

Insol. in absolute alcohol.

Insol. in alcohol, the sp. gr. of which is 0·905. (Anthon.)

Solubility in dil. alcohol increases with the temp.

100 pts. alcohol of 0·939 sp. gr. (53 % by vol., 45 % by weight) dissolve at:

4°	8°	60°
0·16	0·21	0·92 pts. K_2SO_4.

(Gerardin, A. ch. (4) **5.** 147.)

100 pts. of the sat. solution at 15° in alcohol of:

	10	20	30	40 % by weight,
contain	3·9	1·46	0·56	0·21 pts. K_2SO_4.

(Schiff, A. **118.** 362.)

Sol. in 76 pts. glycerine of 1·225 sp. gr. at ordinary temp. (Vogel; N. Repert. **16.** 557.)

Insol. in acetone. (Krug and M'Elroy.)

Min. *Glaserite.*

+ ½H_2O. 100 pts. H_2O dissolve 9·82 pts. (Ogier, C. R. **82.** 1055.)

***Tri*potassium hydrogen sulphate,** $K_3H(SO_4)_2$.

Sol. in H_2O.

Potassium hydrogen sulphate, $KHSO_4$.

1·07 pts. $KHSO_4$ (= 1 pt. $K_2S_2O_7$) dissolve:

At	0°	in 2·95	pts. H_2O.
,,	20°	,, 2·08	,,
,,	40°	,, 1·59	,,
,,	100°	,, 0·88	,,

(Kremers, Pogg. **92.** 497.)

Sat. solution boils at 105·5° (Griffiths); 108° (Kremers).

Alcohol dissolves out H_2SO_4.

K_2SO_4 crystallises from dilute solutions.

Sp. gr. of $KHSO_4$ + Aq at 15° containing:

5	10	15 % $KHSO_4$,
1·0354	1·0726	1·1116
20	25	27 % $KHSO_4$.
1·1516	1·1920	1·2110

(Kohlrausch, W. Ann. **1879.** 1.)

Min. *Misenite.*

+ 5½H_2O. Deliquescent. (Senderens, Bull. Soc. (3) **2.** 278.)

Potassium *di*hydrogen sulphate, $K_4H_2(SO_4)_3$.

Sol. in H_2O. (Phillips, Phil. Mag. **1.** 429.)

Composition is $4K_2O, 7SO_3 + 3H_2O$, according to Berthelot (A. ch. (4) **30.** 442).

Potassium *tri*hydrogen sulphate, $KH_3(SO_4)_2$.

Sol. in H_2O with rise of temperature. (Schultz, Pogg. **133.** 137.)

+ 1½H_2O. (Lescœur, C. R. **78.** 1044.)

Potassium *di*sulphate (*pyro*sulphate), $K_2S_2O_7$.

When dissolved in exactly the necessary amount of hot H_2O for solution, it crystallises on cooling without decomp. Decomp. by excess of H_2O. (Jacquelain, A. ch. **70.** 311.)

Potassium hydrogen *di*sulphate, KHS_2O_7.

Sol. in fuming H_2SO_4 without decomposition.

Potassium *octo*sulphate, $K_2S_8O_{25}$.

Decomp. by H_2O. (Weber.)

Potassium rhodium sulphate, $3K_2SO_4$, $Rh_2(SO_4)_3$.

Does not exist. (Leidié, C. R. **107.** 234.)

Potassium samarium sulphate, $9K_2SO_4$, $2Sm_2(SO_4)_3 + 3H_2O$.

Sl. sol. in H_2O.

Sl. sol. in sat. K_2SO_4 + Aq.

1 l. sat. K_2SO_4 + Aq dissolves 0·5 g. Sm_2O_3. (Cleve, Bull. Soc. (2) **43.** 166.)

Potassium scandium sulphate, $3K_2SO_4$, $Sc_2(SO_4)_3$.

Very slowly sol. in cold, more easily sol. in warm H_2O. Insol. in sat. K_2SO_4 + Aq.

$2K_2SO_4$, $Sc_2(SO_4)_3$. Sol. in K_2SO_4 + Aq. (Cleve.)

Does not exist. (Nilson.)

Potassium sodium sulphate, $3K_2SO_4$, Na_2SO_4.

100 pts. H_2O dissolve 40·8 pts. at 103·5°. (Penny, Phil. Mag. (4) **10.** 401.)

$5K_2SO_4$, Na_2SO_4. 100 pts. H_2O at 100° dissolve 25 pts.; at 12·7°, 10·1 pts.; at 4·4°, 9·2 pts. (Gladstone, Chem. Soc. **6.** 111.)

Potassium strontium sulphate, $K_2Sr_2(SO_4)_3$.

Decomp. by $(NH_4)_2CO_3$ + Aq. (Rose, Pogg. **93.** 604.)

Potassium terbium sulphate.

Easily sol. in H_2O. Sl. sol. in K_2SO_4 + Aq. (Delafontaine, Zeit. Chem. (2) **2.** 230.)

Potassium thallic sulphate, $2K_2O, Tl_2O_3, 4SO_3$.

Insol. in H_2O. Very difficultly sol. in warm dil. H_2SO_4+Aq. (Strecker, A. **135.** 207.)

Potassium thorium sulphate, $2K_2SO_4, Th(SO_4)_2+2H_2O$.

Slowly sol. in cold, easily and abundantly in hot H_2O, and is gradually decomp. by boiling. Easily sol. in acids. Insol. in alcohol. (Berzelius.)

$4K_2SO_4, Th(SO_4)_2+2H_2O$. (Chydenius.)

Potassium stannous sulphate, $K_2SO_4, SnSO_4$.

(Marignac.)

Potassium stannous sulphate chloride, $4K_2SO_4, 4SnSO_4, SnCl_2$.

Can be recrystallised from H_2O. (Marignac, Ann. Min. (5) **12.** 62.)

Potassium titanium sulphate, $K_2SO_4, Ti(SO_4)_2+3H_2O$.

Difficultly sol. in H_2O or HCl+Aq. Decomp. by much H_2O. (Wallace, Pogg. **102.** 453.)

Potassium uranous sulphate, $K_2SO_4, U(SO_4)_2+H_2O$.

Very sl. sol. in H_2O. (Rammelsberg.)

Potassium uranyl sulphate, $K_2SO_4, (UO_2)SO_4+2H_2O$.

Sol. in 9 pts. H_2O at 22° and in 0·51 pt. at 100°. Insol. in alcohol. (Ebelmen, A. ch. (3) **5.** 211.)

$2K_2SO_4, 3(UO_2)SO_4+H_2O$. Sol. in H_2O. Insol. in alcohol. (Berzelius.)

Does not exist. (Ebelmen.)

Potassium vanadium sulphate, $K_2O, V_2O_5, 2SO_3+6H_2O=K(VO_2)SO_4+3H_2O$.

(Friedheim, B. **24.** 1183.)

$=KVO_3, K_2SO_4, V_2O_5, 2SO_3+9H_2O$ of Münzing (Berlin, Dissert. **1889**).

Potassium vanadyl sulphate, $K_2SO_4,(VO)_2(SO_4)_3$.

Very slowly sol. in H_2O, still less sol. in dil. alcohol. (Gerland.)

Potassium yttrium sulphate, $4K_2SO_4, Y_2(SO_4)_3$.

Sol. in 16 pts. cold H_2O, and in 10 pts. sat. K_2SO_4+Aq, and more abundantly if the latter solution contains ammonium salts or free acid. (Berlin.)

$3K_2SO_4, 2Y_2(SO_4)_3$. 100 ccm. cold sat. K_2SO_4+Aq dissolve an amount of this salt corresponding to 4·685 g. Y_2O_3. (Cleve.)

Potassium zinc sulphate, $K_2SO_4, ZnSO_4+6H_2O$.

Sol. in 5 pts. cold H_2O. (Bucholz, N. J. Pharm. **9.** 2. 26.)

100 pts. H_2O dissolve at:

0°	10°	15°	25°	36°
12·6	18·7	22·5	28·8	39·9 pts. hydrous salt,
45°	50°	58°	65°	70°
51·2	54·0	67·6	81·3	87·9 pts. hydrous salt.

(Tobler, A. **95.** 193.)

100 pts. H_2O at 15° dissolve 14·8 pts. $K_2SO_4, ZnSO_4+6H_2O$; sp. gr. of sat. H_2O solution at 15°=1·0939. (Schiff, A. **109.** 326.)

Potassium zirconium sulphate, $2K_2O, 6ZrO_2, 7SO_3+9H_2O$.

Decomp. by H_2O.

$3K_2O, 3ZrO_2, 7SO_3+9H_2O$. Insol. in H_2O.

Potassium sulphate vanadate.

Very difficultly sol. in H_2O. Insol. in alcohol. (Berzelius.)

Potassium sulphate antimony *tri*fluoride.

See **Antimony *tri*fluoride potassium sulphate.**

Rhodium sulphate, $Rh_2(SO_4)_3+12H_2O$.

Easily sol. in H_2O. (Berzelius.)

Sl. sol. in, but not decomp. by H_2O when not more than 16 pts. H_2O are present to 1 pt. salt. Decomp. by hot H_2O to—

$Rh_2(SO_4)_3, Rh_2O_3$. Insol. in H_2O. (Leidié, C. R. **107.** 234.)

Rhodium sodium sulphate, $Rh_2Na_2(SO_4)_4$.

Insol. in H_2SO_4 or aqua regia. (Seubert and Kobbé, B. **23.** 2560.)

Rubidium sulphate, Rb_2SO_4.

100 pts. H_2O dissolve 42·4 pts. at 10°. (Bunsen.)

If solubility S=pts. anhydrous Rb_2SO_4 in 100 pts. solution, S=26·5+0·2959t from 8° to 49°; S=41·0+0·0661t from 49° to 170°. (Étard, C. R. **106.** 741.)

Rubidium hydrogen sulphate, $RbHSO_4$.

Sol. in H_2O.

Rubidium *pyro*sulphate, $Rb_2S_2O_7$.

Decomp. by H_2O.

Rubidium *octo*sulphate, $Rb_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Rubidium zinc sulphate, $Rb_2SO_4, ZnSO_4+6H_2O$.

Sol. in H_2O. (Bunsen and Kopp, Pogg. **113.** 337.)

Ruthenic sulphate, $Ru(SO_4)_2$.

Deliquescent, and easily sol. in H_2O. (Claus, A. **59.** 246.)

Samarium sulphate, $Sm_2(SO_4)_3+8H_2O$.

Difficultly sol. in H_2O.

Much less sol. than $Di_2(SO_4)_3+8H_2O$. (Cleve.)

Samarium sodium sulphate, $Sm_2(SO_4)_3, Na_2SO_4+2H_2O$.

Sl. sol. in sat. Na_2SO_4+Aq. (Cleve, Bull. Soc. (2) **43.** 166.)

Scandium sulphate, $Sc_2(SO_4)_3$.

Anhydrous. Easily sol. in H_2O.

$+2H_2O$.

$+6H_2O$. Extremely sol. in H_2O, but not deliquescent.

Scandium sodium sulphate, $Sc_2(SO_4)_3, 3Na_2SO_4+12H_2O$.

Sol. in H_2O. (Cleve.)

Argentoargentic sulphate, $Ag_4SO_4, Ag_2SO_4+H_2O$.

Gradually sol. in conc., but not attacked by dil., HNO_3+Aq. Not attacked by hot conc. H_2SO_4. (Lea, Sill. Am. J. **144.** 322.)

Silver sulphate, Ag_2SO_4.

Sol. in 200 pts. cold, and less than 100 pts. boiling H_2O. (Wittstein.)

Sol. in 88 pts. boiling H_2O (Schnaubart); in 87·25 pts. boiling H_2O (Wenzel); in 68·85 pts. H_2O at 100° (Kremers).

100 pts. H_2O at 15·5° dissolve 1·15 pts. Ag_2SO_4. (Ure's Dict.)

Sol. in 160 pts. H_2O at 18·75°. (Abl.)

B.-pt. of sat. Ag_2SO_4 + Aq is 100°. (Kremers.)

100 pts. H_2O dissolve 0·58 pt. at 18°. 100 pts. $(NH_4)_2SO_4$ + Aq (15 %) dissolve 0·85 pt. Ag_2SO_4 at 18°. Other sulphates have little effect. (Eder, J. pr. (2) **17.** 44.)

More sol. in H_2SO_4 + Aq than in pure H_2O. Still more sol. in HNO_3 + Aq and still more in conc. H_2SO_4, from which it is pptd. by H_2O. (Schnaubart.)

Very sol. in a hot mixture of H_2SO_4 and monobrombenzene, less sol. in cold. (Couper, A. ch. (3) **52.** 311.)

Decomp. by alkali thiosulphates + Aq. (Herschell.)

Sol. in NH_4OH, and $(NH_4)_2CO_3$ + Aq.

Silver hydrogen sulphate, $AgHSO_4$.

Decomp. by H_2O; sol. in H_2SO_4. (Stas.)

Ag_2O, $3H_2O$, $4SO_3 + 2H_2O = AgH_3(SO_4)_2 + H_2O$. As above. (Schultz, Pogg. **133.** 137.)

$2Ag_2O$, $3H_2O$, $5SO_3 + 2H_2O = Ag_4H_6(SO_4)_5 + 2H_2O$. As above. (Schultz.)

Silver *pyro***sulphate,** $Ag_2S_2O_7$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Silver thallic sulphate, $AgTl(SO_4)_2$.

(Lepsius, Chem. Ztg. **1890.** 1327.)

Silver sulphate ammonia, Ag_2SO_4, $2NH_3$.

Completely sol. in H_2O. (Rose, Pogg. **20.** 153.)

Ag_2SO_4, $4NH_3$. Easily sol. in H_2O or NH_4OH + Aq without decomp. (Mitscherlich.)

Silver sulphate sulphide, Ag_2SO_4, Ag_2S.

Decomp. by hot H_2O or cold HCl + Aq. Sol. in boiling HNO_3 + Aq. (Poleck and Thümmel, B. **16.** 2435.)

Sodium sulphate, Na_2SO_4.

Anhydrous.

1 pt. Na_2SO_4 is sol. in 7·367 pts. H_2O at 15° (Gerlach); in 8·52 pts. H_2O at 13·3° (Poggendorf); in 10 pts. H_2O at 13°, and in 3·3 pts. H_2O at 62·2° (Wenzel).

100 pts. H_2O at 0° dissolve 5·155 pts. Na_2SO_4 (Pfaff, A. **99.** 226); at 100·6° dissolve 45·985 pts. Na_2SO_4 (Griffiths).

See below for further data.

$+7H_2O$. Efflorescent. Insol. in alcohol.

See below for further data.

$+10H_2O$.

Sol. in 2·33 pts. H_2O at 19°, or 100 pts. H_2O at 19° dissolve 42·8 pts. $Na_2SO_4 + 10H_2O$. (Schiff, A. **109.** 326.)

100 pts. H_2O dissolve a pts. Na_2SO_4 and b pts. $Na_2SO_4 + 10H_2O$ at t°.

t°	a	b	t°	a	b
0	5·02	12·17	33·88	50·04	312·11
11·67	10·12	26·38	40·15	48·78	291·44
13·30	11·74	31·33	45·04	47·81	276·91
17·91	16·73	48·28	50·40	46·82	262·35
25·05	28·11	99·48	59·79	45·42	..
28·76	37·35	161·53	70·61	44·35	..
30·75	43·05	215·77	84·42	42·96	..
31·84	47·37	270·22	103·17	42·65	..
32·73	50·65	322·12	..	..	..

(Gay-Lussac, A. ch. (2) **11.** 312.)

Maximum solubility is at 33° from experiment and theoretical considerations. At this temp. $Na_2SO_4 + 10H_2O$ is converted into Na_2SO_4. (Kopp, A. **34.** 271.)

100 pts. H_2O at t° dissolve pts. $Na_2SO_4 + 10H_2O$.

t°	Pts. $Na_2SO_4 + 10H_2O$	t°	Pts. $Na_2SO_4 + 10H_2O$	t°	Pts. $Na_2SO_4 + 10H_2O$
2·5	11·39	37·50	294·04	75	241·68
7·5	16·38	43·75	261·04	81·25	217·20
12·5	29·03	50	285·06	87·50	220·65
18·75	70·78	56·25	248·11	93·75	225·46
25	143·38	62·5	222·22	100	241·69
31·25	479·97	68·75	242·88	..	..

(Brandes and Firnhaber, **1824.**)

1 pt. $Na_2SO_4 + 10H_2O$ is sol. in 6·1 pts. H_2O at 7·5°; 3·44 pts. at 12·5°; 2·41 pts. at 18·75°; and 1·724 pts. at 20°. (Karsten.)

1 pt. $Na_2SO_4 + 10H_2O$ is sol. in 2·86 pts. cold, and 0·8 pt. boiling H_2O (Bergmann); in 3 pts. cold, and 0·5 pt. boiling H_2O (Wittstein); in 4 pts. cold, and 1 pt. boiling H_2O (Fourcroy); in 3 pts. H_2O at 18·75° (Abl).

100 pts. H_2O dissolve 12·494 pts. Na_2SO_4 or 35·492 pts. $Na_2SO_4 + 10H_2O$ at 15°, and sp. gr. of solution = 1·10847 (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve 39·4 pts. cryst. salt at 15·5°; 80 pts. cryst. salt at 100°. (Ure's Dict.)

100 pts. H_2O dissolve pts. Na_2SO_4 at t°.

t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4
0	4·53	24·1	25·92
17·9	16·28	33	50·81

(Diacon, J. B. **1866.** 61.)

Solubility of Na_2SO_4 in H_2O at various pressures and temp. Pts. Na_2SO_4 contained in 100 pts. sat. Na_2SO_4 + Aq at A pressure in atmos. and t° are given.

A	0°	15°	15·4°	A	15°
1	4·40	11·32	11·4	30	10·05
20	4·53	10·78	10·74	40	10·33

(Möller, Pogg. **117.** 386.)

The solubility of $Na_2SO_4 + 10H_2O$ increases with the temperature from 0 to 34°. At 34° and above, it is converted into the anhydrous salt, the solubility of which is least at 103·17°, which is the boiling-point of the saturated solution, and increases by cooling from that temp. down to 18-17°. Below the latter temperature the anhydrous salt cannot exist in the presence of H_2O, but is converted into $Na_2SO_4 + 7H_2O$, or $Na_2SO_4 + 10H_2O$. The solubility of $Na_2SO_4 + 7H_2O$ increases with the temperature from 0-26°, and at 27° it is converted into the anhydrous salt.

Thus there are two different rates of solubility for Na_2SO_4 for temperatures from 0-18°, three different rates from 18-26°, two from 26-34°, and only one above 34°.

1. By heating $Na_2SO_4 + 10H_2O$ to fusion and raising the heat until the liquid boils, placing in a closed vessel and cooling, the greater part of the anhydrous salt, which separates out on

heating, redissolves on cooling, and the amount increases as the temp. falls until 18° is reached. Below 18° $Na_2SO_4+7H_2O$ is formed. Saturated Na_2SO_4 + Aq thus obtained contains for 100 pts. H_2O at:

18°	20°	25°	26°	
53·25	52·76	51·53	51·31	pts. Na_2SO_4,

30°	33°	34°	36°	
50·37	49·71	49·53	49·27	pts. Na_2SO_4.

2. By allowing the boiling saturated solution free from undissolved salt to cool to 0° with exclusion of air until crystals of $Na_2SO_4+7H_2O$ are formed, then removing the greater part of the mother liquor with a warm pipette, and warming the rest of the mother liquor with the excess of crystals, the crystals dissolve in increasing quantity between 0° and 26-27°, so that at 27° the solution contains 56 pts. Na_2SO_4 to 100 pts. H_2O. The remaining undissolved crystals of $Na_2SO_4+7H_2O$ begin to melt very slowly at 27°, more quickly at higher temperatures, and cause the separation of anhydrous crusts, and thus the strength of the solution is gradually lowered to the normal. Saturated solutions prepared in this way contain for 100 pts. H_2O at:

	0°	10°	13°	
	19·62	30·49	34·27	pts. Na_2SO_4,
or	44·89	78·9	92·9	pts. $Na_2SO_4+7H_2O$,

	15°	16°	17°	
	37·43	38·73	39·99	pts. Na_2SO_4,
or	105·8	117·4	111·0	pts. $Na_2SO_4+7H_2O$,

	18°	19°	20°	
	41·63	43·35	44·73	pts. Na_2SO_4,
or	124·6	133·0	140·0	pts. $Na_2SO_4+7H_2O$,

	25°	26°	
	52·94	54·97	pts. Na_2SO_4.
or	188·5	202·6	pts. $Na_2SO_4+7H_2O$,

3. Solutions obtained by shaking H_2O with $Na_2SO_4+10H_2O$ contain for 100 pts. H_2O at:

	0°	10°	15°	
	5·02	9·00	13·20	pts. Na_2SO_4,
or	12·16	23·04	35·96	pts. $Na_2SO_4+10H_2O$,

	18°	20°	25°	
	16·80	19·40	28·00	pts. Na_2SO_4,
or	48·41	58·85	98·48	pts. $Na_2SO_4+10H_2O$,

	26°	30°	
	30·00	40·00	pts. Na_2SO_4,
or	109·81	184·1	pts. $Na_2SO_4+10H_2O$,

	33°	34°	
	50·76	55·0	pts. Na_2SO_4.
or	323·1	412·2	pts. $Na_2SO_4+10H_2O$.

At 34° $Na_2SO_4+10H_2O$ begins to melt in its crystal H_2O. As long as there is a considerable quantity of unchanged crystals present, the solution contains 55 pts. Na_2SO_4 for 100 pts. H_2O, but as the hydrous salt decreases in amount and becomes converted into the anhydrous salt, the solution becomes weaker and contains only 49·53 pts. Na_2SO_4 for 100 pts. H_2O after warming for 6 or 8 hours at 34°. In the same way temporary solutions can be obtained at 36-40° with 55-56 pts. Na_2SO_4 to 100 pts. H_2O, but this amount sinks to the normal even more quickly than at 34°.

Na_2SO_4 dehydrated at 100-150°, after the addition of $1\frac{1}{4}$-$1\frac{2}{3}$ pts. H_2O, gives a solution between 0° and 32° of the same strength as $Na_2SO_4+10H_2O$, but at 34° a solution with 55 pts. Na_2SO_4 to 100 pts. H_2O cannot be obtained, but one with 49·53 pts. is formed. (Löwel, A. ch. (3) **49.** 32.)

4. Solubility of anhydrous salt. Above 34°, 100 pts. H_2O dissolve at:

35°	40°	45°	50°	55°	
50·2	48·8	47·7	46·7	45·9	pts. Na_2SO_4,

60°	65°	70°	75°	80°	
45·3	44·8	44·4	44·0	43·7	pts. Na_2SO_4,

85°	90°	95°	100°	103·5°	
43·3	43·1	42·8	42·5	42·2	pts. Na_2SO_4.

(Mulder.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4
0	4·8	35	50·2	70	44·4
1	5·1	36	49·9	71	44·3
2	5·4	37	49·6	72	44·2
3	5·7	38	49·3	73	44·2
4	6·0	39	49·1	74	44·1
5	6·4	40	48·8	75	44·0
6	6·8	41	48·5	76	44·0
7	7·3	42	48·3	77	43·9
8	7·8	43	48·1	78	43·8
9	8·4	44	47·9	79	43·7
10	9·0	45	47·7	80	43·7
11	9·7	46	47·5	81	43·6
12	10·5	47	47·3	82	43·5
13	11·4	48	47·1	83	43·5
14	12·4	49	46·9	84	43·4
15	13·4	50	46·7	85	43·3
16	14·5	51	46·6	86	43·3
17	15·7	52	46·4	87	43·2
18	16·9	53	46·2	88	43·2
19	18·2	54	46·1	89	43·1
20	19·5	55	45·9	90	43·1
21	20·9	56	45·8	91	43·0
22	22·5	57	45·7	92	43·0
23	24·1	58	45·6	93	42·9
24	25·9	59	45·4	94	42·9
25	27·9	60	45·3	95	42·8
26	30·1	61	45·2	96	42·7
27	32·4	62	45·1	97	42·6
28	35·0	63	45·0	98	42·6
29	37·8	64	44·9	99	42·5
30	40·9	65	44·8	100	42·5
31	44·2	66	44·7	101	42·4
32	47·8	67	44·6	102	42·3
32·75	50·65	68	44·5	103	42·2
33	50·6	69	44·5	103·5	42·2
34	50·4	...	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 123.)

100 pts. dissolve at:

0°	34°	100°	120°
5	78·8 (?)	42·7	41·95 pts. Na_2SO_4,
140°	160°	180°	230°
42·0	42·9	44·25	46·4 pts. Na_2SO_4.

(Tilden and Shenstone, Lond. R. Soc. Proc. **35**. 345.)

Solubility decreases above 230°. (Étard, C. R. **113**. 854.)

Supersaturated solutions of $NaSO_4$ are easily formed; when Na_2SO_4+Aq sat. at its b.-pt. is hermetically sealed, no crystals are deposited on cooling (Löwel). Supersat. Na_2SO_4+Aq may also be obtained by cooling hot sat. Na_2SO_4+Aq in flasks loosely stoppered with cotton wool (Schroeder, A. **109**. 45), or by covering the containing vessel with a glass plate, watch-glass, card, etc., or by covering the liquid itself with a layer of oil, and then allowing to cool.

Hot Na_2SO_4+Aq containing 1 pt. H_2O to 1 pt. $Na_2SO_4+10H_2O$ does not crystallise on slowly cooling or on being quickly cooled by immersion in cold water, if it is contained in a barometer tube freed from air by boiling, or in an exhausted well-closed vessel, or in an open vessel with a layer of oil of turpentine on it (Gay-Lussac); or in a vessel containing air, either well stoppered or furnished with a loose cover (Schweigger); or in an open vessel under a bell jar full of air and closed at the bottom with a water joint; or in open bottles placed in a quiet situation; or in an open glass enclosed in a stoppered vessel, containing air and some KOH for drying; in this case $Na_2SO_4+10H_2O$ effloresces from the solution, and when washed down again does not cause instant crystallisation, but redissolves.

The crystallisation of a solution cooled in this way may often be brought about instantaneously, or often again after a short time: (1) by agitation, when the solution has been cooled in an open vessel; (2) by access of air caused by opening the vessel, the crystallisation taking place the more rapidly the larger the opening. In this case the crystallisation begins at the top, where the solution, the vessel, and the air come in contact; when a particle of dust falls in the liquid the crystallisation begins a little under the surface. When the solution has been cooled in vacuo, a bubble of air, hydrogen, carbonic acid, or nitrous oxide is sufficient to set up the crystallisation; (3) by contact with a solid body. The latter do not cause crystallisation when cooled in contact with the liquid, nor (excepting a crystal of $Na_2SO_4+10H_2O$) when they are moistened or warmed before contact with the solution.

Supersat. Na_2SO_4+Aq is brought to crystallisation by addition of a crystal of $Na_2SO_4+10H_2O$, or an isomorphous substance as $Na_2SeO_4+10H_2O$, or $Na_2CrO_4+10H_2O$. Other crystals, as $MgSO_4+7H_2O$, etc., have no action. (Thomson, Chem. Soc. **35**. 199.)

A more extended discussion of the phenomena and causes of supersaturation is not considered to be within the scope of this work.

Na_2SO_4+Aq sat. at 15° has sp. gr. 1·10847 (Michel and Krafft); at 15° has sp. gr. 1·119 (Stolba); at 16° has sp. gr. 1·1162 (Stolba); at 10° contains 29 pts. Na_2SO_4 to 100 pts. H_2O (supersaturated ?), and has sp. gr. 1·1259 (Karsten).

Sp. gr. of Na_2SO_4+Aq at 19·5°.

% Na_2SO_4	Sp. gr.	% Na_2SO_4	Sp. gr.
2·894	1·0262	10·538	1·0977
5·589	1·0509	12·478	1·1162
7·995	1·0733	..	..

(Kremers, Pogg. **95**. 120.)

Sp. gr. of Na_2SO_4+Aq.

% $Na_2SO_4+10H_2O$	Sp. gr.	% $Na_2SO_4+10H_2O$	Sp. gr.
1·262	1·005	13·744	1·055
2·522	1·010	14·975	1·060
3·780	1·015	16·203	1·065
5·035	1·020	17·426	1·070
6·288	1·025	18·645	1·075
7·538	1·030	19·860	1·080
8·786	1·035	21·071	1·085
10·030	1·040	22·277	1·090
11·272	1·045	23·478	1·095
12·510	1·050	24·674	1·100

(Schmidt, Pogg. **132**. 132.)

Sp. gr. of Na_2SO_4+Aq at 19°.

% $Na_2SO_4+10H_2O$	Sp. gr.	% $Na_2SO_4+10H_2O$	Sp. gr.
1	1·0040	16	1·0642
2	1·0079	17	1·0683
3	1·0118	18	1·0725
4	1·0158	19	1·0766
5	1·0198	20	1·0807
6	1·0232	21	1·0849
7	1·0278	22	1·0890
8	1·0318	23	1·0931
9	1·0358	24	1·0973
10	1·0398	25	1·1015
11	1·0439	26	1·1057
12	1·0479	27	1·1100
13	1·0520	28	1·1142
14	1·0560	29	1·1184
15	1·0601	30	1·1226

(Schiff, A. **110**. 70.)

Sp. gr. of Na_2SO_4+Aq at 15°.

%	Sp. gr. if Na_2SO_4	Sp. gr. if $Na_2SO_4+10H_2O$	%	Sp. gr. if $Na_2SO_4+10H_2O$	%	Sp. gr. if $Na_2SO_4+10H_2O$
1	1·0091	1·004	11	1·044	21	1·086
2	1·0182	1·008	12	1·047	22	1·090
3	1·0274	1·013	13	1·052	23	1·094
4	1·0365	1·016	14	1·056	24	1·098
5	1·0457	1·020	15	1·060	25	1·103
6	1·0550	1·024	16	1·064	26	1·107
7	1·0644	1·028	17	1·069	27	1·111
8	1·0737	1·032	18	1·073	28	1·116
9	1·0832	1·036	19	1·077	29	1·120
10	1·0927	1·040	20	1·082	30	1·125

(Gerlach, Z. anal. **8**. 287.)

Sp. gr. of Na_2SO_4+Aq at 24·8°. a=No. of g., equivalent to ½ mol. wt., dissolved in 1000 g. H_2O; b=sp. gr. if a is $Na_2SO_4+10H_2O$, ½ mol. wt.=161; c=sp. gr. if a is Na_2SO_4, ½ mol. wt.=71.

a	b	c	a	b	c
1	1·054	1·059	4	1·163	1·213
2	1·098	1·114	5	1·188	...
3	1·134	1·165	6	1·209	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of Na_2SO_4+Aq at 18°.

% Na_2SO_4	Sp. gr.	% Na_2SO_4	Sp. gr.
5	1·0450	15	1·1426
10	1·0915	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of Na_2SO_4+Aq at 20° containing 0·5 mol. Na_2SO_4 to 100 mols. H_2O=1·03466; 1·0 mol. Na_2SO_4 to 100 mols. H_2O=1·06744. (Nicol, Phil. Mag. (5) **16.** 122.)

$Na_2SO_4+10H_2O$ is sol. in H_2O with absorption of heat; 20 pts. $Na_2SO_4+10H_2O$ mixed with 100 pts. H_2O at 12·5° lower the temperature 6·8°. (Rüdorff, B. **2.** 68.)

Sp. gr. and b.-pt. of Na_2SO_4+Aq. Na_2SO_4+Aq containing P pts. $Na_2SO_4+10H_2O$ for every 100 pts. H_2O has given sp. gr. and b.-pt.

P	Sp. gr.	B.-pt.	P	Sp. gr.	B.-pt.
1	1·005	100·5°	16	1·064	101·25°
2	1·008	100·62	17	1·067	101·25
3	1·014	100·62	18	1·070	101·37
4	1·020	100·75	19	1·072	101·37
5	1·021	100·75	20	1·074	101·37
6	1·028	100·87	21	1·076	101·37
7	1·030	100·87	22	1·078	101·5
8	1·032	101·0	23	1·080	101·5
9	1·036	101·0	24	1·082	101·5
10	1·040	101·0	25	1·084	101·5
11	1·043	101·12	26	1·090	101·5
12	1·050	101·12	27	1·092	101·63
13	1·055	101·25	28	1·095	101·63
14	1·060	101·25	29	1·098	101·63
15	1·062	101·25	30	1·100	101·75

(Brandes and Gruner, **1827.**)

Saturated solution boils at 103·17° (Löwel), 103·5° (Mulder), 105° (Kremers), 100·5° (Griffiths), 100·8° (Gerlach).

Crust forms at 102·9°; highest temp., 103·2°, and solution contains 43·9 pts. Na_2SO_4 to 100 pts. H_2O. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of Na_2SO_4+Aq containing pts. Na_2SO_4 to 100 pts. H_2O.

B.-pt.	Pts. Na_2SO_4	B.-pt.	Pts. Na_2SO_4
100·5°	9·5	102·5°	39·0
101·0	18·0	103·0	44·5
101·5	26·0	103·2	46·7
102·0	33·0	...	...

(Gerlach, Z. anal. **26.** 430.)

M.-pt. of $Na_2SO_4+10H_2O$=34°. (Tilden, Chem. Soc. **45.** 409.)

Sol. with decomp. in HCl+Aq.

More sol. in K_2SO_4, $CuSO_4$, $MgSO_4$+Aq than in H_2O. (Pfaff, A. **99.** 226.)

100 pts. H_2O dissolve 20·7 pts. $CuSO_4$ and 15·9 pts. Na_2SO_4. (Rüdorff, B. **6.** 484.)

Sol. in sat. $MgSO_4$, K_2SO_4, $CuSO_4$+Aq, but if more Na_2SO_4 than can be dissolved is added to the $CuSO_4$+Aq, a large quantity of a double sulphate separates out. (Karsten.)

See also under $CuSO_4$, $MgSO_4$, and K_2SO_4.

Slowly but abundantly sol. in sat. $ZnSO_4$+Aq, with separation of a double salt after a few days.

Sol. in sat. NH_4Cl+Aq.

Rapidly and abundantly sol. in sat. KCl+Aq with pptn. of K_2SO_4.

$Na_2SO_4+10H_2O$ is sol. in sat. NaCl+Aq without pptn. If effloresced Na_2SO_4 is used, a ppt. of NaCl is caused at first, and subsequently of $Na_2SO_4+10H_2O$. (Karsten.)

Sol. in boiling sat. NaCl+Aq with pptn. of NaCl, but from cold solutions the Na_2SO_4 separates out first. (Vauquelin.)

Less sol. in NaCl+Aq than in H_2O. (Hunt, Am. J. Sci. (2) **25.** 368.)

Sol. in sat. KNO_3+Aq with pptn. after several hours. (Karsten.)

$Na_2SO_4+10H_2O$ is sol. in sat. $NaNO_3$+Aq without pptn., but if effloresced Na_2SO_4 is used, $NaNO_3$ is pptd. at first, and subsequently $Na_2SO_4+7H_2O$.

Sol. in sat. NH_4NO_3+Aq. (Margueritte, C. R. **38.** 307.)

Alcohol precipitates $Na_2SO_4+10H_2O$ from the cold saturated aqueous solution. (Brandes and Firnhaber.)

Insol. in alcohol of from 0·817 to 0·90 sp. gr. (Kirwan.)

1000 pts. alcohol of 0·872 sp. gr. dissolve 0·7 pt. Na_2SO_4 at 12·5-15°; of 0·905 sp. gr. dissolve 3·5 pts. Na_2SO_4 at 12·5-15°.

Insol. in alcohol of 0·83-0·85 sp. gr. (Anthon.)

From supersaturated solution in alcohol crystals with $7H_2O$ are formed. (Schiff, A. **106.** 11.)

100 pts. 10 % alcohol at 15° contain 14·35 pts. $Na_2SO_4+10H_2O$; 20 % alcohol at 15° contain 5·6 pts. $Na_2SO_4+10H_2O$; 40 % alcohol at 15° contain 1·3 % $Na_2SO_4+10H_2O$. (Schiff, A. **118.** 365.)

Very sl. sol. in abs. alcohol at ord. temp.; somewhat more, though still exceedingly sparingly, sol. in abs. alcohol acidulated with H_2SO_4. (Fresenius.)

Alcohol does not affect crystal H_2O of $Na_2SO_4+10H_2O$.

Sol. in glycerine.

Sl. sol. in conc. $HC_2H_3O_2$. (Ure's Dict.)

Not pptd. by addition of glacial $HC_2H_3O_2$ to Na_2SO_4+Aq. (Persoz.)

Min. Anhydrous, *Thenardite.* $+10H_2O$, *Mirabilite.*

Sodium hydrogen sulphate, $NaHSO_4$.

Not deliquescent. Very sol. in H_2O with decomposition.

Sol. in 2 pts. H_2O at 0° (Link); 1 pt. H_2O

at 100° (Schubarth). 100 pts. H_2O at 15·5° dissolve 92·72 pts. Sol. in 2 pts. H_2O at 18·75° (Abl); decomp. by alcohol.

$+H_2O$. Deliquescent, and decomp. by the H_2O which it takes up.

$NaH_3(SO_4)_2$. Decomp. by H_2O. (Schultz.)

***Tri*sodium hydrogen sulphate**, $Na_3H(SO_4)_2$.

Sol. in H_2O with decomp.

$+H_2O$. (Rose.)

Sodium *pyro*sulphate, $Na_2S_2O_7$.

Sol. in fuming H_2SO_4 without decomp.

Sodium thallic sulphate, Na_2SO_4, $Tl_2(SO_4)_3$.

Sol. in H_2O. (Strecker, A. **135**. 207.)

Sodium thorium sulphate, Na_2SO_4, $Th(SO_4)_2+6H_2O$.

Sol. in H_2O. 100 pts. cold sat. Na_2SO_4+Aq dissolve 4 pts. of this salt. (Cleve.)

Sodium yttrium sulphate, Na_2SO_4, $Y_2(SO_4)_3+2H_2O$.

Quite sol. in H_2O. (Cleve.)

Sodium zinc sulphate, Na_2SO_4, $ZnSO_4+4H_2O$.

Deliquescent in moist air.

Decomp. into constituents on dissolving in H_2O. (Graham, Phil. Mag. **18**. 417.)

Sodium sulphate fluoride, Na_2SO_4, NaF.

Cryst. from H_2O without decomp. (Marignac, Ann. Min. (5) **15**. 236.)

Sodium sulphate antimony *tri*fluoride.

See **Antimony *tri*fluoride sodium sulphate.**

Strontium sulphate, $SrSO_4$.

Very sl. sol. in cold, and still less in boiling H_2O.

1 l. H_2O at 11-15° dissolves 0·066 g. $SrSO_4$ (Brandes and Silber); 0·145 g. $SrSO_4$ (Fresenius); 0·154-0·167 g. $SrSO_4$ (Marignac); 0·187 g. $SrSO_4$ (Kremers); 0·278 g. $SrSO_4$ (Andrews).

1 l. boiling H_2O dissolves 0·104 g. $SrSO_4$ (Fresenius); 0·282 g. $SrSO_4$ (Brandes and Silber).

When a Sr salt is precipitated by H_2SO_4, 1 pt. $SrSO_4$ remains dissolved in 700 pts. H_2O. (Marignac.)

Calculated from electrical conductivity of the solution, $SrSO_4$ is sol. in 10,070 pts. H_2O at 16·1° and 10,090 pts. at 20·1°. (Holleman, Z. phys. Ch. **12**. 131.)

1 l. H_2O dissolves 107 mg. $SrSO_4$ at 18° and not much more at higher temp. (Kohlrausch and Rose, Z. phys. Ch. **12**. 241.)

Sol. in about 8000 pts. H_2O. (Schweitzer, J. B. **1877**. 1054.)

Sol. in 6895 pts. cold, and 9638 pts. boiling H_2O; in 11,000-12,000 pts. H_2O containing H_2SO_4; in 474 pts. $HCl+Aq$ containing 8·5 % HCl; in 432 pts. HNO_3+Aq containing 4·8 % N_2O_5; in 7843 pts. $HC_2H_3O_2+Aq$ containing 15·6 % $HC_2H_3O_2$. (Fresenius.)

Or, 1 l. cold $HCl+Aq$ of 8·5 % dissolves 2·11 g. $SrSO_4$; 1 l. cold HNO_3+Aq of 4·8 % N_2O_5 dissolves 2·31 g. $SrSO_4$; 1 l. cold $HC_2H_3O_2+Aq$ of 15·6 % $HC_2H_3O_2$ dissolves 0·1275 g. $SrSO_4$. (Fresenius.)

Sol. in conc. H_2SO_4. *See under* $SrH_2(SO_4)_2$.

Insol. in NH_4Cl+Aq or conc. $(NH_4)_2SO_4+Aq$. (Rose.)

Slowly but completely sol. in $NaCl+Aq$. (Wackenroder.)

H_2O containing Na_2SO_4 dissolves less $SrSO_4$ than pure H_2O; H_2O containing H_2SO_4 still less. (Andrews, Phil. Mag. Ann. **7**. 406.)

Insol. in NH_4Cl+Aq.

Insol. in $Na_2S_2O_3+Aq$.

Insol. in boiling conc. $(NH_4)_2SO_4+Aq$. (Rose, Pogg. **110**. 292.)

Sol. in 16,949 pts. $(NH_4)_2SO_4+Aq$ (1 : 4). (Fresenius, Z. anal. **32**. 195.)

Pptn. is hindered by alkali metaphosphates and citrates, but not by citric acid.

Decomp. at ord. temp., and more rapidly on boiling by alkali carbonates + Aq.

Sol. in $MgCl_2$ or $KCl+Aq$, solubility increasing with strength of solution; sol. in $NaCl$ or $CaCl_2+Aq$, maximum solubility occurring when the solutions are of a medium concentration. The numerical results are as follows:

100 pts. of the salt solutions containing given pts. salt dissolve pts. $SrSO_4$.

Salt	Pts. salt	Pts. $SrSO_4$
$NaCl$	22·17	0·1811
	15·54	0·2186
	8·44	0·1653
KCl	18·08	0·2513
	12·54	0·1933
	8·22	0·1925
$MgCl_2$	13·63	0·2419
	4·03	0·2057
	1·59	0·1986
$CaCl_2$	33·70	0·1706
	16·51	0·1853
	8·67	0·1756

(Virck, C. C. **1862**. 402.)

Insol. in absolute alcohol; scarcely sol. in dil. alcohol.

Min. *Celestite.*

Strontium hydrogen sulphate, $SrH_2(SO_4)_2$.

100 pts. H_2SO_4 dissolve 2·2 pts. $SrSO_4$ (Lies-Bodart and Jacquemin); 100 pts. H_2SO_4 dissolve 5·68 pts. (Struve, Z. anal. **9**. 34); 100 pts. fuming H_2SO_4 dissolve 9·77 pts. (Struve).

1 g. $SrSO_4$ dissolves in 1256 g. 91 % H_2SO_4+Aq (Varenne and Pauleau, C. R. **93**. 1016); boiling H_2SO_4 dissolves about 15 % $SrSO_4$, and still more at 100° (Schultz, Pogg. **133**. 147).

Sol. in 1519 pts. 91 % H_2SO_4. (Varenne and Pauleau, C. R. **93**. 1016.)

100 pts. H_2SO_4 (sp. gr. 1·843) dissolve 14 pts. $SrSO_4$ at 70°. (Garside, C. N. **31**. 245.)

Decomp. by H_2O.

$+H_2O$. Decomp. by H_2O.

Tantalum sulphate, $3Ta_2O_5, SO_3+9H_2O$.
(Hermann, J. pr. **70**. 201.)

Tellurium sulphate, basic, TeO_2, SO_3.
Sol. in cold dil. H_2SO_4. Decomp. by hot H_2O. (Klein, C. R. **99**. 326.)

Terbium sulphate, $Tr_2(SO_4)_3+8H_2O$.
Sol. in H_2O.

Thallous sulphate, Tl_2SO_4.
1 pt. dissolves at t° in pts. H_2O, according to C=Crookes; L=Lamy:

15°	18°	62°	100°	101·2°	
21·1	20·8	8·7	5·4	5·22	pts. H_2O.
C	L	L	C	L	

Thallous hydrogen sulphate, $TlHSO_4+3H_2O$.
Decomp. by H_2O. (Oettinger.)

Thallous *pyro*sulphate, $Tl_2S_2O_7$.
Decomp. by H_2O. (Weber, B. **17**. 2502.)

Thallous *octo*sulphate, $Tl_2S_8O_{25}$.
Decomp. by H_2O. (Weber, B. **17**. 2502.)

Thallic sulphate, basic, $Tl_2O_3, 2SO_3+3H_2O$.
Sol. in H_2O.
$+5H_2O$. As above. (Willm, A. ch. (4) **5**. 5.)

Thallic sulphate, $Tl_2(SO_4)_3+7H_2O$.
Decomp. by cold H_2O with separation of $TlO(OH)$. (Crookes.)

Thallothallic sulphate, $2Tl_2O, 3Tl_2O_3, 12SO_3+25H_2O$.
Gradually efflorescent. (Willm.)
$Tl_2(SO_4)_2$. (Lepsius, Chem. Ztg. **1890**. 1327.)
$TlH(SO_4)_2$. (Lepsius.)

Thallous zinc sulphate, $Tl_2SO_4, ZnSO_4+6H_2O$.
Sol. in H_2O. (Willm.)

Thorium sulphate, basic, $3[Th(SO_4)_2+2H_2O]$, $Th(SO_4)O+2H_2O$.
Insol. in H_2O; very slowly attacked by dil. acids. (Demarçay.)

Thorium sulphate, $Th(SO_4)_2$.
Anhydrous. Easily sol. if brought into a large amount of H_2O, but very slowly sol. if only a little H_2O is added to the salt.

100 pts. H_2O dissolve about 4·86 pts. $Th(SO_4)_2$ at 0°. (Cleve.)

When heated, a hydrous salt separates out, which redissolves on cooling. (Cleve.)

Solubility of anhydrous salt cannot be determined, as it begins to separate out $Th(SO_4)_2+9H_2O$ before a saturated solution is reached. At 0° 100 pts. H_2O dissolved 22·97 pts. $Th(SO_4)_2$ in 15 minutes; at 25°, 27·00 pts. $Th(SO_4)_2$ were dissolved in 5 minutes. (Roozeboom, Z. phys. Ch. **5**. 198.)

$+2H_2O$. Shows same behaviour as anhydrous salt. 100 pts. H_2O dissolved 35·50 pts. $Th(SO_4)_2$ from this salt at 1°, but this is not the maximum solubility. (Roozeboom.)

$+4H_2O$. Pptd. by alcohol from hot aqueous solution; also formed by heating $Th(SO_4)_2+9H_2O$ in aqueous solution above 60°.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+4H_2O$, calculated as $Th(SO_4)_2$, at t°. D=according to Demarçay (C. R. **96**. 1860); R=according to Roozeboom (Z. phys. Ch. **5**. 202).

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
17	9·41 D	50	2·54 R	70	1·09 R
35	4·50 D	55	1·94 D	75	1·32 D
40	4·04 R	60	1·634 R	95	0·71 D

$+6H_2O$. Behaves as the anhydrous salt, but action is much slower.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+6H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	1·50	45	3·85
15	1·63	60	6·64
30	2·45	...	...

(Roozeboom.)

This determination gives too low figures, especially at the higher temperatures. (Roozeboom.)

$+8H_2O$.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+8H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	1·00	25	1·85
15	1·38	44	3·71

$+9H_2O$. Pptd. by alcohol from cold aqueous solution. Sol. in about 88 pts. H_2O at 0°. (Cleve.) Extremely slowly sol. in H_2O.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+9H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	0·88	30	1·85	50	4·86
10	1·02	40	2·83	55	6·5±
20	1·25	...	...	...	...

Above 55° $Th(SO_4)_2+4H_2O$ separates out.
(Demarçay C. R. **96**. 1860, calculated by Roozeboom.)

100 pts. H_2O dissolve pts. $Th(SO_4)_2+9H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	0·74	30	1·995	50	5·22
10	0·98	40	2·998	55	6·76
20	1·38	...	...	...	...

Above 60° $Th(SO_4)_2+4H_2O$ separates out.
(Roozeboom, Z. phys. Ch. **5**. 201.)

For further data, see Roozeboom (Z. phys. Ch. **5**. 198), where there is a full discussion of the subject.

Stannous sulphate, $SnSO_4$.

Sol. in 5·3 pts. H_2O at 19°, and 5·5 pts. at 100°. (Marignac.) Solution soon decomposes with separation of a basic salt. Sol. in H_2SO_4+Aq. (Bouquet.)

Stannic sulphate, basic, $(SnO)SO_4+H_2O$.

Easily sol. in cold H_2O, but quickly decomp. with separation of stannic hydroxide. (Ditte, C. R. **104**. 178.)

Stannic sulphate, $Sn(SO_4)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O; decomp. by much H_2O. Sol. in dil. H_2SO_4+Aq. Slowly sol. in $HCl+Aq$. Decomp. by absolute alcohol. (Ditte, C. R. **104**. 178.)

Titanium sulphate, $Ti(SO_4)_2+3H_2O$.

Deliquescent, and sol. in H_2O. The aqueous solution is decomp. on boiling. (Glatzel, B. **9**. 1833.)

Titanium *sesqui*sulphate, $Ti_2(SO_4)_3$.

Very deliquescent, and easily sol. in H_2O. Aqueous solution is decomp. by boiling. (Ebelmen.)

$+8H_2O$. Sol. in H_2O. (Glatzel, B. **9**. 1833.)

Titanyl sulphate, $(TiO)SO_4$.

Decomp. by H_2O. Slowly sol. in cold, rapidly in warm $HCl+Aq$. (Merz, J. pr. **99**. 157.)

Uranous sulphate, basic, $U(OH)_2SO_4+H_2O$.

Insol. in H_2O. H_2O dissolves out H_2SO_4. (Ebelmen, A. ch. (3) **5**. 217.)

Uranous sulphate, $U(SO_4)_2+4H_2O$.

Decomp. by H_2O into insol. basic, and sol. acid salts. Sol. in dil. H_2SO_4 or $HCl+Aq$. Difficultly sol. in conc. acids. (Ebelmen, A. ch. (3) **5**. 215.)

$+8H_2O$. As above. (Rammelsberg.)

Min. *Johannite*. Sl. sol. in H_2O.

Uranyl sulphate, basic, $3UO_3, SO_3+2H_2O$.

(Athanasesco.)

$+14H_2O$. Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26**. 208.)

$4UO_3, SO_3+7H_2O$. (Athanasesco, C. R. **103**. 271.)

Uranyl sulphate, $(UO_2)SO_4$.

Anhydrous.

$+3\frac{1}{2}$ or $3H_2O$. Efflorescent. Very sol. in H_2O and alcohol.

1 pt. is sol. in 0·6 pt. cold H_2O; in 0·45 pt. boiling H_2O; in 25 pts. cold absolute alcohol; in 20 pts. boiling absolute alcohol. (Bucholz.)

Sol. in 0·47 pt. H_2O at 21°, and 0·28 pt. boiling H_2O. (Ebelmen.)

100 pts. H_2O at 15·5° dissolve 160 pts., and at 100°, 220 pts. (Ure's Dict.)

Completely pptd. from $(UO_2)SO_4+Aq$ by $HC_2H_3O_2$. (Persoz.)

Uranyl sulphate, acid, $(UO_2)SO_4, H_2SO_4$.

Very deliquescent. (Schultz-Sellack.)

Uranyl *pyro*sulphate, $(UO_2)S_2O_7$.

Very deliquescent. Hisses with H_2O.

Uranouranyl sulphate, $USO_4, (UO_2)SO_4$.

Sol. in H_2O. (Ebelmen.) Decomp. by boiling. (Berzelius.)

Min. *Voglianite*.

Vanadious sulphate, $V_2O_3, 4SO_3+9H_2O$.

Sol. in H_2O. (Brierley, Chem. Soc. **49**. 882.)

Vanadium sulphate, $V_2O_5, 2SO_3=(VO_2)_2S_2O_7$.

Deliquescent. Easily sol. in H_2O.

$V_2O_5, 3SO_3$. Deliquescent. Sol. in H_2O and alcohol.

$+3H_2O$. Deliquescent. Very sol. in H_2O, but decomp. by boiling. Sol. in alcohol. (Ditte, C. R. **102**. 757.)

***Di*vanadyl sulphate,** $V_2O_2(SO_4)_2$.

Insol. in H_2O, HCl, or H_2SO_4+Aq, but on heating to 400° becomes sol. in H_2O if heated to 130° therewith. (Gerland.)

$+4H_2O$. Very slowly sol. in H_2O at 10°, quickly at 60°, and still more rapidly at 100°. Deliquesces in warm moist air more quickly than it dissolves in H_2O at 10°. Insol. in absolute alcohol. Very sol. in alcohol of 0·833 sp. gr. (Berzelius.)

$+7H_2O$, and $10H_2O$.

$+13H_2O$. Efflorescent. (Gerland.)

***Di*vanadyl hydrogen sulphate,**

$(V_2O_2)H_2(SO_4)_3=V_2O_4, 3SO_3+H_2O$.

$+2H_2O$.

$+3H_2O$. Deliquescent. Very slowly sol. in cold H_2O or alcohol. Easily sol. in hot H_2O. (Gerland.)

$+5H_2O$. Deliquescent. Insol. in ether. Scarcely sol. in alcohol. Slowly sol. in cold, easily in hot H_2O. (Crow.)

$+14H_2O$. Easily sol. in cold H_2O or dil. alcohol. (Gerland.)

Ytterbium sulphate, $Yb_2(SO_4)_3+8H_2O$.

Quite slowly sol. in H_2O even at 100°. Anhydrous salt is easily sol. in much H_2O, but if little H_2O is used the hydrous salt is formed, which only slowly dissolves. Sol. in K_2SO_4+Aq.

Yttrium sulphate, basic, $Y_2O_3, SO_3=(YO)_2SO_4$.

Insol. in H_2O. (Berzelius.)

$2Y_2O_3, SO_3+10H_2O$. (Cleve.)

Yttrium sulphate, $Y_2(SO_4)_3$.

Anhydrous. More sol. in H_2O than the hydrous salt, and more sol. in cold than hot H_2O. Solution sat. at 0° separates $Y_2(SO_4)_3+8H_2O$ at 50°. 100 pts. H_2O dissolve 15·2 pts. anhydrous salt. at ord. temp.

Easily sol. in large amount of sat. K_2SO_4+Aq, from which $3K_2SO_4, 2Y(SO_4)_3$ is pptd. on warming. (Cleve and Höglund, Sv. V. A. H. Bih. **1**. No. 8.)

$+8H_2O$. 100 pts. H_2O dissolve 9·3 pts. of cryst. salt at ord. temp., and 4·8 pts. at 100°. (Cleve, Bull. Soc. (2) **21**. 344.)

Less sol. in H_2O containing H_2SO_4 than in pure H_2O. (Berzelius.)

Completely pptd. by $HC_2H_3O_2$+Aq. Insol. in alcohol.

Zinc sulphate, basic, $8ZnO, SO_3+2H_2O$.

Insol. in H_2O. (Schindler, Mag. Pharm. **31.** 181.)

$6ZnO, SO_3+10H_2O$. Insol. in H_2O. (Kane, A. ch. **72.** 310.)

$4ZnO, SO_3+2H_2O$. Scarcely sol. in hot or cold H_2O. Sol. in $ZnSO_4$+Aq. (Kühn, Schw. J. **60.** 337.)

$+5H_2O$. Nearly insol. in H_2O. (Habermann, M. **5.** 432.)

$+7H_2O$. (Athanasesco, C. R. **103.** 271.)

$+10H_2O$. (Schindler.)

$3ZnO, SO_3$. Insol. in cold, sl. sol. in hot H_2O. (Vogel.)

$2ZnO, SO_3$. (Athanasesco.)

Zinc sulphate, $ZnSO_4$.

Sol. in H_2O with evolution of heat.

Sol. in HCl+Aq.

$+H_2O$. (Étard.)

$+2H_2O$. Insol. in alcohol. (Kühn.)

$+3\frac{1}{2}H_2O$. (Anthon.)

$+5H_2O$. Insol. in boiling alcohol of 0·86 sp. gr. (Kühn.)

$+6H_2O$. (Marignac.)

$+7H_2O$. Slowly efflorescent.

1 pt. of the crystals dissolves in 0·923 pt. H_2O at 17·5°, and forms a solution of 1·4353 sp. gr. (Karsten.)

100 pts. $ZnSO_4$+Aq sat. at 18-20° contain 35·36 pts. $ZnSO_4$. (v. Hauer, J. B. **1866.** 59.)

100 pts. H_2O dissolve at:

0°	20°	50°	75°	
41·3	53·0	66·9	80·4	pts. $ZnSO_4$.

(Tobler, J. B. **1855.** 309.)

Sol. in 2+ pts. H_2O at ord. temp., and in less at 100°. (Bergmann.)

100 pts. H_2O at 104·4° dissolve 81·81 pts. $ZnSO_4$. (Griffiths.)

100 pts. H_2O at ord. temp. dissolve 140 pts. $ZnSO_4+7H_2O$. (Dumas.)

Sol. in 2·29 pts. H_2O at 18·75°. (Abl.)

100 pts. H_2O at 15·56° dissolve 140 pts. $ZnSO_4+7H_2O$. (Ure's Dict.)

100 pts. H_2O at 15° dissolve 140·53 pts. $ZnSO_4+7H_2O$, and has sp. gr. =1·4442. (Michel and Krafft.)

100 pts. H_2O at 20·5° dissolve 163·2 pts. $ZnSO_4+7H_2O$. (Schiff, A. **109.** 336.)

100 pts. H_2O at t° dissolve pts. anhydrous $ZnSO_4$, and pts. $ZnSO_4+7H_2O$.

t°	Pts. $ZnSO_4$	Pts. $ZnSO_4+7H_2O$	t°	Pts. $ZnSO_4$	Pts. $ZnSO_4+7H_2O$
0	43·02	115·22	60	74·20	313·48
10	48·36	138·21	70	79·25	369·36
20	53·13	161·49	80	84·60	442·62
30	58·40	190·90	90	89·78	533·02
40	63·52	224·05	100	95·03	653·59
50	68·75	263·84	...	...	...

(Poggiale, A. ch. (3) **8.** 467.)

Solubility of $ZnSO_4$ in 100 pts. H_2O at t°.

t°	Pts. $ZnSO_4$	t°	Pts. $ZnSO_4$	t°	Pts. $ZnSO_4$
0	44·0	14	52·8	27	62·1
1	44·6	15	53·5	28	62·8
2	45·2	16	54·2	29	63·6
3	45·8	17	54·9	30	64·3
4	46·4	18	55·6	31	65·1
5	47·0	19	56·3	32	65·8
6	47·6	20	57·0	33	66·6
7	48·3	21	57·7	34	67·3
8	48·9	22	58·4	35	68·1
9	49·5	23	59·2	36	68·8
10	50·2	24	59·9	37	69·3
11	50·8	25	60·7	38	70·4
12	51·5	26	61·4	39	71·2
13	52·2	...	...	...	...

Decomp. into basic salt above 40°.
(Mulder, Scheik. Verhandel. **1864.** 74.)

If solubility S represents number of pts. anhydrous salt in 100 pts. of solution, S=27·6+0·2604t from −5° to +81°; S=50·0−0·2244t from 81° to 175°. (Étard, C. R. **106.** 207.)

Sat. $ZnSO_4$+Aq at 8° has sp. gr.=1·421. (Anthon.)

Sp. gr. of $ZnSO_4+7H_2O$ at 20·5°.
%=% $ZnSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr	%	Sp. gr.
1	1·0057	21	1·1288	41	1·2754
2	1·0115	22	1·1355	42	1·2834
3	1·0173	23	1·1423	43	1·2917
4	1·0231	24	1·1491	44	1·3000
5	1·0289	25	1·1560	45	1·3083
6	1·0348	26	1·1629	46	1·3167
7	1·0407	27	1·1699	47	1·3252
8	1·0467	28	1·1770	48	1·3338
9	1·0527	29	1·1842	49	1·3424
10	1·0588	30	1·1914	50	1·3511
11	1·0649	31	1·1987	51	1·3599
12	1·0710	32	1·2060	52	1·3688
13	1·0772	33	1·2134	53	1·3779
14	1·0835	34	1·2209	54	1·3871
15	1·0899	35	1·2285	55	1·3964
16	1·0962	36	1·2362	56	1·4057
17	1·1026	37	1·2439	57	1·4151
18	1·1091	38	1·2517	58	1·4246
19	1·1156	39	1·2595	59	1·4342
20	1·1222	40	1·2674	60	1·4439

(Schiff, A. **110.** 72.)

Sp. gr. of $ZnSO_4$+Aq at 15°.
%=% $ZnSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·006	8	1·047	15	1·0905
2	1·013	9	1·053	16	1·097
3	1·019	10	1·0593	17	1·103
4	1·024	11	1·066	18	1·110
5	1·0288	12	1·073	19	1·116
6	1·035	13	1·079	20	1·1236
7	1·041	14	1·085	21	1·130

Sp. gr. $ZnSO_4+Aq$ etc.—*Continued.*

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
22	1·137	35	1·231	48	1·337
23	1·143	36	1·240	49	1·346
24	1·150	37	1·246	50	1·3532
25	1·1574	38	1·255	51	1·362
26	1·164	39	1·263	52	1·370
27	1·171	40	1·2709	53	1·380
28	1·179	41	1·280	54	1·390
29	1·185	42	1·288	55	1·3986
30	1·1933	43	1·295	56	1·408
31	1·200	44	1·304	57	1·416
32	1·209	45	1·3100	58	1·425
33	1·216	46	1·320	59	1·435
34	1·224	47	1·330	60	1·4451

(Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $ZnSO_4+Aq$ at 23·5°. a=No. of g., equivalent to ½ mol. wt., dissolved in 1000 g. H_2O ; b=sp. gr. if a is $ZnSO_4+7H_2O$, ½ mol. wt.=143·5 ; c=sp. gr. if a is $ZnSO_4$, ½ mol. wt.=80·5.

a	b	c	a	b
1	1·077	1·084	7	1·368
2	1·143	1·162	8	1·400
3	1·199	1·236	9	1·428
4	1·249	1·307	10	1·453
5	1·294	1·376	11	1·476
6	1·333	1·443	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $ZnSO_4+Aq$ at 18°.

% $ZnSO_4$	Sp. gr.	% $ZnSO_4$	Sp. gr.	% $ZnSO_4$	Sp. gr.
5	1·0509	15	1·1675	25	1·3045
10	1·1369	20	1·2313	30	1·3788

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $ZnSO_4+Aq$ at t°. S=pts. $ZnSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
24·7170	1·3152	14·0307	1·1645
21·4444	1·2665	9·7426	1·1106
17·7573	1·2145	5·1110	1·0565

(Charpy, A. ch. (6) **29.** 27.)

M.-pt. of $ZnSO_4+7H_2O=50°$. (Tilden, Chem. Soc. **45.** 409.)

Sat. $ZnSO_4+Aq$ boils at 104·4°, and solution contains 45 pts. $ZnSO_4$ to 100 pts. H_2O. (Griffiths.)

Crust forms at 103·5°, the solution containing 68 pts. $ZnSO_4$ to 100 pts. H_2O. Highest temp. observed, 105°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $ZnSO_4+Aq$ containing pts. $ZnSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $ZnSO_4$	B.-pt.	Pts. $ZnSO_4$
100·5°	13·1	103·0°	61·0
101·0	25·0	103·5	68·0
101·5	37·7	104·0	74·9
102·0	45·4	104·5	80·7
102·5	53·9	105·0	85·7

(Gerlach, Z. anal. **26.** 432.)

Liable to form supersaturated solutions.

Completely pptd. from $ZnSO_4+Aq$ by $HC_2H_3O_2$. (Persoz.)

Very rapidly sol. in sat. K_2SO_4+Aq, with separation of a double salt. (Karsten.)

Very rapidly and abundantly sol. in sat. Na_2SO_4+Aq.

Abundantly sol. in sat. $CuSO_4+Aq$.

Slowly sol. in sat. $MgSO_4+Aq$.

Difficultly and slowly sol. in sat. NH_4Cl+Aq, with separation of a double sulphate.

Sol. in considerable quantity in sat. $NaCl+Aq$, without pptn. at first, but finally Na_2SO_4 separates out.

Sol. in sat. $NaNO_3+Aq$ as in $NaCl+Aq$.

Sol. in sat. KNO_3+Aq with immediate pptn. of double sulphate. (Karsten.)

Insol. in alcohol of 0·88 sp. gr. ; 1000 pts. alcohol of 0·905 sp. gr. dissolve 2 pts. (Anthon.)

100 pts. of a saturated solution in 40 % alcohol contain 3·48 pts. $ZnSO_4+7H_2O$; 20 %, 39 pts.; 10 %, 51·1 pts. (Schiff, J. B. **1861.** 87.)

100 pts. absolute methyl alcohol dissolve 0·65 pt. $ZnSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. absolute methyl alcohol dissolve 59 pts. $ZnSO_4+7H_2O$ at 17°.

100 pts. 50 % methyl alcohol dissolve 15·7 pts. $ZnSO_4+7H_2O$ at 17°. (de Bruyn.)

Min. *Gosslarite.*

Zinc sulphate, acid, $ZnH_2(SO_4)_2+8H_2O$.

Somewhat difficultly sol. in cold, easily in hot H_2O. (v. Kobell, J. pr. **28.** 492.)

Zinc sulphate ammonia, basic, $4NH_3$, $4ZnO$, SO_3+4H_2O.

Ppt. (Schindler.)

Zinc sulphate ammonia, $ZnSO_4$, $2NH_3$.

$+H_2O$. Decomp. by H_2O into basic zinc sulphate.

$ZnSO_4$, $4NH_3+4H_2O$. Sol. in H_2O. (Kane, A. ch. **72.** 304.)

$+3H_2O$. (André, C. R. **100.** 241.)

$ZnSO_4$, $5NH_3$. Sol. in H_2O with partial decomp. (Rose, Pogg. **20.** 149.)

Zirconium sulphate, basic, $3ZrO_2$, $2SO_3$.

Insol. in H_2O. Sol. in $HCl+Aq$. (Paykull, B. **12.** 1719.)

$7ZrO_2$, $6SO_3$. Insol. in H_2O. (Endemann, J. pr. (2) **11.** 219.)

ZrO_2, SO_3. Sol. in very little H_2O. More H_2O decomp. into $3ZrO_2$, $2SO_3$ and $Zr(SO_4)_2$. (Berzelius.)

Zirconium sulphate, $Zr(SO_4)_2$.

Anhydrous. Slowly but completely sol. in cold, quickly in hot H_2O.

Sol. in warm H_2SO_4, but separates on cooling. Precipitated from aqueous solution by alcohol.

$+4H_2O$. Easily sol. in H_2O.

$3ZrO_2$, $4SO_3+15H_2O$. Sol. in H_2O. (Paykull.)

$6ZrO_2$, $7SO_3+19H_2O$. Sol. in H_2O. (Paykull.)

$3ZrO_2$, SO_3. Insol. in boiling H_2O. (Franz, B. **3.** 58.)

*Per*sulphuric acid, HSO_4.

See **Persulphuric acid.**

*Pyro*sulphuric acid *and pyro*sulphates.

See under **Sulphuric acid** *and* **sulphates.**

Sulphuric boric acid.

See **Borosulphuric acid.**

Sulphuric vanadic acid, V_2O_5, $3SO_3+3HO_2$.

See **Sulphate, vanadium.**

Sulphurous acid, anhydrous, SO_2.

See **Sulphur** ***di*****oxide.**

Sulphurous acid, H_2SO_3.

Known only in aqueous solution, from which SO_2 is given off upon heating. Crystallises in cold, with various amounts of water, forming compounds which approximate $H_2SO_3+8H_2O$ (Pierre, A. **68.** 228); $H_2SO_3+10H_2O$ (Döpping, Bull. Ac. St. Pétersb. **7.** 100); $H_2SO_3+14H_2O$ (Schönfeld, A. **95.** 22); $H_2SO_3+6H_2O$ (Roozeboom, R. t. c. **3.** 29, 59, 75, 84; Geuther, A. **224.** 218). Crystals are sol. in 2 pts. H_2O at 10°. (Pierre.)

For sp. gr. of solutions, etc., see sulphur dioxide.

Sulphites.

Normal. Only the alkali sulphites are sol. in H_2O, and they are insol. or only sl. sol. in alcohol.

Acid. All the acid sulphites are sol. in H_2O.

Aluminum sulphite, basic, Al_2O_3, SO_2+4H_2O.

Insol. in H_2O; sol. in H_2SO_3+Aq. (Fourcroy and Vauquelin.)

Ammonium sulphite, basic, $(NH_4)_2SO_3$, $NH_3+\frac{1}{2}H_2O$.

Sol. in H_2O. Pptd. from aqueous solution by alcohol. (Muspratt.)

Does not exist. (Marignac.)

Ammonium sulphite, $(NH_4)_2SO_3+H_2O$.

Slowly sol. in H_2O. (Muspratt, A. **50.** 268.)

Sol. in 1 pt. H_2O at 12°. (Fourcroy and Vauquelin, Crell. Ann. **1800**, **2.** 415.)

More sol. in hot H_2O with evolution of NH_3. Sl. sol. in absolute alcohol. (Muspratt.)

Much more sol. in alcohol than K_2SO_3. (Pierre.)

Ammonium *pyro*sulphite, $(NH_4)_2S_2O_5$.

Deliquescent. Very sol. in H_2O and alcohol. Insol. in ether. (Fock and Klüss, B. **23.** 3149.)

Ammonium cadmium sulphite, $(NH_4)_2SO_3$, $CdSO_3$.

Nearly insol. in H_2O. Partly sol. in excess of H_2SO_3+Aq, but separates out on boiling. (Schüler, A. **87.** 34.)

Ammonium cobaltous sulphite, $(NH_4)_2SO_3$, $CoSO_3+xH_2O$.

Decomp. on air. (Berglund, B. **7.** 469.)

Ammonium cobaltocobaltic sulphite.

See **Cobaltisulphite, ammonium cobalt.**

Ammonium cuprous sulphite, $(NH_4)_2SO_3$, $2Cu_2SO_3+2H_2O$.

(Böttinger, A. **51**, 411.)

$(NH_4)_2SO_3$, Cu_2SO_3. Insol. in cold, decomp. by boiling H_2O. (Rogojski, J. B. **1851.** 366.)

$+2H_2O$. (Commaille, J. B. **1867.** 300.)

$5(NH_4)_2SO_3$, $Cu_2SO_3+2H_2O$. Decomp. on air. Sol. in H_2O with decomp. (Svensson.)

$7(NH_4)_2SO_3$, $Cu_2SO_3+10H_2O$. Decomp. on air. Sl. sol. in warm, less sol. in cold H_2O. (de Saint-Gilles.)

$+14H_2O$. Decomp. on air. Sol. in H_2O, but solution decomp.

Very easily sol. in mother liquor. (Svensson, Acta Lund. **1869.** 13.)

Ammonium cuprocupric sulphite, $(NH_4)_2SO_3$, $2Cu_2SO_3$, $CuSO_3+5H_2O$.

Insol. in H_2O and weak acids. Sol. in NH_4OH+Aq. (de Saint-Gilles, A. ch. (3) **42.** 31.)

Ammonium aurous sulphite, $3(NH_4)_2SO_3$, Au_2SO_3.

Very easily sol. in H_2O. Insol. in alcohol. (Haase, Z. Ch. **1869.** 535.)

Ammonium aurous sulphite ammonia, $(NH_4)_2SO_3$, $3Au_2SO_3$, $6NH_3+H_2O$.

Decomp. by H_2O. Sol. in warm NH_4OH+Aq, but decomp. by boiling.

Ammonium iridium sulphite.

See **Iridosulphite, ammonium.**

Ammonium ferrous sulphite, $(NH_4)_2SO_3$, $FeSO_3+xH_2O$.

(Berglund.)

Ammonium magnesium sulphite, $(NH_4)_2Mg_3(SO_3)_4+18H_2O$.

Very sl. sol. in H_2O. (Fourcroy and Vauquelin.)

Sol. in H_2SO_3+Aq.

$+5H_2O$. Much more sol. in H_2O than $MgSO_3$. (Rammelsberg.)

Ammonium manganous sulphite, $(NH_4)_2SO_3$, $MnSO_3$.

Relatively easily decomp. by H_2O. (Berglund, Bull. Soc. (2) **21.** 213.)

Not easily decomp. (Gorgeu, C. R. **96.** 376.)

Ammonium mercuric sulphite, $(NH_4)_2SO_3$, $HgSO_3$.

Very easily sol. in H_2O, but H_2O solution gradually decomp., even in the cold.

Ammonium nickel sulphite, $(NH_4)_2SO_3, 3NiSO_3 + 18H_2O$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium platinous sulphite.

See **Platosulphite, ammonium.**

Ammonium potassium sulphite, $10(NH_4)_2SO_3, K_2SO_3 + 11H_2O$.

Decomp. by H_2O, etc. (Hartog, C. R. **109.** 221.)

Ammonium silver sulphite, $(NH_4)_2SO_3, Ag_2SO_3$.

Insol. in H_2O, but gradually decomp. thereby. (Svensson, B. **4.** 714.)

$6(NH_4)_2SO_3, Ag_2SO_3 + 19H_2O$. Sol. in H_2O without decomp. (Svensson.)

$3(NH_4)_2SO_3, 4NH_4HSO_3, Ag_2SO_3 + 18H_2O$. Easily sol. in H_2O, but decomp. by warming.

Ammonium sodium hydrogen sulphite, $NH_4Na_2H(SO_3)_2 + 4H_2O$.

Not deliquescent. (Marignac, Ann. Min. (5) **12.** 29.)

100 pts. H_2O dissolve 42·3 pts. salt at 12·4°, and 48·5 pts. at 15°. (Schwicker, B. **22.** 1732.)

$+ 5H_2O = 2Na_2SO_3, (NH_4)_2S_2O_5 + H_2O$. (Tauber, Techn. J. B. **1888.** 444.)

Ammonium tellurium sulphite, $(NH_4)_2SO_3, TeSO_3 + xH_2O$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium uranyl sulphite, $NH_4(UO_2)(OH)SO_3$.

Insol. in pure H_2O. More sol. in H_2SO_3 + Aq than the K salt, and less than the Na salt. (Scheller, A. **144.** 240.)

Ammonium zinc sulphite, $(NH_4)_2SO_3, ZnSO_3$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium sulphite mercuric chloride, $2(NH_4)_2SO_3, HgCl_2$.

Sl. sol. in cold, decomp. by boiling H_2O. (de St-Gilles, A. ch. (3) **36.** 95.)

Antimony sulphite, $Sb_2O_3, 3SO_2$ (?).

Insol. in H_2O. (Berzelius.)

Could not be obtained. (Röhrig, J. pr. (2) **37.** 241.)

Barium sulphite, $BaSO_3$.

Very sl. sol. in H_2O. (Fourcroy and Vauquelin, A. ch. **24.** 301.)

Sol. in H_2SO_3 + Aq.

Barium cobaltic sulphite.

See **Cobaltisulphite, barium.**

Barium aurous sulphite, $3BaSO_3, Au_2SO_3 + xH_2O$.

Ppt. (Haase.)

Barium mercuric sulphite, $BaSO_3, HgSO_3 + H_2O$.

Ppt. (Barth, Z. phys. Ch. **9.** 196.)

Bismuth sulphite, basic, $Bi_2O_3, 3SO_2 + 5H_2O$.

Insol. in H_2O, alcohol, or ether. Sl. sol. in H_2SO_3 + Aq. (Röhrig, J. pr. (2) **37.** 241.)

Bismuth cobaltic sulphite.

See **Cobaltisulphite, bismuth.**

Cadmium sulphite, $CdSO_3$.

Difficultly sol. in H_2O. Easily sol. in dil. acids. (Rammelsberg, Pogg. **67.** 256.)

$+ 2H_2O$. Difficultly sol. in H_2O. Sol. in H_2SO_3 + Aq. Sol. in NH_4OH + Aq. Insol. in alcohol. (Muspratt, Phil. Mag. (3) **30.** 414.)

Contains $2\frac{1}{2}H_2O$. (Deniges, Bull. Soc. (3) **7.** 569.)

Cadmium sodium sulphite, $3CdSO_3, Na_2SO_3$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Cadmium sulphite, ammonia, $CdSO_3, NH_3$.

Decomp. by H_2O. Sol. without decomp. in hot NH_4OH + Aq. (Rammelsberg, Pogg. **67.** 256.)

Calcium sulphite, basic, $Ca_6S_5O_{16} = 6CaO, 5SO_2$.

(Schott, Dingl. **202.** 52.)

Calcium sulphite, $CaSO_3 + 2H_2O$.

Slowly effloresces. Sol. in 800 pts. cold H_2O. (Berzelius.)

Insol. in H_2O. (Röhrig, J. pr. (2) **37.** 230.)

Very sol. in H_2SO_3 + Aq. *See* $CaH_2(SO_3)_2$.

Insol. in acetone. (Krug and M'Elroy.)

$+ \frac{1}{2}H_2O$. (Rammelsberg.)

Calcium hydrogen sulphite, $CaH_2(SO_3)_2$.

Known only in solution.

100 ccm. H_2O containing 9 g. SO_2 dissolve 0·553 g. $CaSO_3$ to form a solution of 1·06 sp. gr. (Gerland, J. pr. (2) **4.** 119.)

Calcium cobaltic sulphite.

See **Cobaltisulphite, calcium.**

Cerous sulphite, $Ce_2(SO_3)_3 + 3H_2O$.

More sol. in cold than hot H_2O.

Solution gradually decomposes. (Berthier, A. ch. (3) **7.** 77.)

Chromous sulphite, $CrSO_3$.

Precipitate. Insol. in H_2O. (Moberg.)

Chromic sulphite.

Known only in aqueous solution, which precipitates a basic salt on boiling.

$2Cr_2O_3, 3SO_2 + 16H_2O$. Precipitate. (Danson, Chem. Soc. **2.** 205.)

Chromic potassium sulphite, $K_2O, Cr_2O_3, 2SO_2 + xH_2O$.

Precipitate. (Berglund, B. **7.** 470.)

Cobaltous sulphite, basic.

Ppt. Decomp. by H_2O. (Berthier.)

Cobaltous sulphite, $CoSO_3$.

$+ 3H_2O$. Nearly insol. in H_2O. Sol. in H_2SO_3 + Aq. (Rammelsberg.)

Partly sol. in NH_4OH + Aq.

$+ 5H_2O$. Insol. in H_2O. Sol. in H_2SO_3 + Aq. (Muspratt, A. **30.** 282.)

Cobaltocobaltic sulphite.

See **Cobaltisulphite, cobaltous.**

Cobaltic sulphite *with* $\mathbf{3M_2SO_3}$.

See **Cobaltisulphite, M.**

Cobaltous potassium sulphite, $CoSO_3$, $K_2SO_3+xH_2O$.

Insol. in H_2O; easily sol. in $HCl+Aq$. (Schultze, J. B. **1864**. 270.)

Cobaltic potassium sulphite, $Co_2(SO_3)_3$, K_2SO_3.

Sl. sol. in H_2O; easily sol. in H_2SO_3+Aq or $HCl+Aq$. (Schultze.)

Cobaltous sodium sulphite, $3CoO$, Na_2O, $3SO_2$.

Insol. in H_2O. Easily sol. in $HCl+Aq$. (Schultze.)

Cobaltic sodium sulphite, Co_2O_3, Na_2O, $3SO_2$.

Sl. sol. in H_2O. (Schultze.)

Cuprous sulphite, $Cu_2SO_3+H_2O$.

(a) *Red.* Sl. sol. in H_2O. Sol. in NH_4OH or $HCl+Aq$. (Rogojski, J. B. **1851**. 366.)

Could not be obtained by St. Gilles or Svensson (B. **4**. 713).

Insol. in H_2O, alcohol, or ether. (Étard, C. R. **95**. 38.)

Composition is $(Cu_2)_8H_{16}(SO_4)_8$, "Cuprous isosulphite," according to Étard.

(β) *White. Normal salt.* Insol. in H_2O, alcohol, or ether. (Étard.)

Cupric sulphite, basic, $4CuO$, SO_2+7H_2O.

Insol. in H_2O, and decomp. by washing therewith. (Millon and Commaille.)

$3CuO, 2SO_2+1\frac{1}{2}H_2O$. Sl. sol. in H_2O. (Newbury, Am. Ch. J. **14**. 232.)

Cuprocupric sulphite, $CuSO_3$, $Cu_2SO_3+2H_2O$.

Nearly insol. in cold H_2O. Decomp. by boiling.

Sol. in H_2SO_3+Aq, HCl, or NH_4OH+Aq. (Berthier.)

Sol. in very dil. HNO_3+Aq. (Döpping, J. B. **1851**. 365.)

Insol. in H_2SO_3, $HC_2H_3O_2$, or Cu salts$+Aq$. (de St. Gilles.)

$+5H_2O$. Insol. in H_2O. Easily sol. in H_2SO_3+Aq, $HC_2H_3O_2+Aq$, in cupric salts $+Aq$, NH_4OH+Aq, or $HCl+Aq$. (de St. Gilles, A. ch. (3) **42**. 34.)

Composition is $(Cu^{I}_2)Cu^{II}_{10}H_{10}(SO_4)_8+21H_2O$, "acid cuprosocupric *octo*sulphite." (Étard, C. R. **96**. 1475.)

Cuprous ferroferric sodium sulphite, Cu_2O, $2FeO$, Fe_2O_3, Na_2O, $6SO_2+16H_2O$.

Sol. in about 1000 pts. H_2O.

Sol. in cold dil. H_2SO_4+Aq; sol. in cold dil. $HCl+Aq$ with a residue of Cu_2Cl_2. (Stromeyer, A. **109**. 237.)

Cuprous lithium sulphite, Cu_2SO_3, $Li_2SO_3+2H_2O$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **95**. 138.)

Cupric mercuric sulphite, $CuSO_3$, $HgSO_3$.

Sol. in H_2O in all proportions, but decomp. on boiling.

Cuprous potassium sulphite, Cu_2SO_3, K_2SO_3 (?). (Vohl, J. pr. **95**. 219.)

$+2H_2O$. (Étard, C. R. **95**. 138.)

Cu_2SO_3, $2K_2SO_3$. (Chevreul, Graham, etc.) Does not exist. (Svensson.)

$Cu_2O, 3K_2O, 6SO_2+7H_2O=4KHSO_3, K_2SO_3, Cu_2SO_3+5H_2O$. Decomp. by H_2O. (Svensson, B. **4**. 713.)

$Cu_2O, 4K_2O, 8SO_2+3H_2O=6KHSO_3, K_2SO_3, Cu_2SO_3$. Decomp. by H_2O. (Svensson.)

Cu_2SO_3, $8K_2SO_3+16H_2O$. Sol. in H_2O with decomp. (Rammelsberg, Pogg. **57**. 391.)

Does not exist, according to Svensson.

Cuprous sodium sulphite, Cu_2SO_3, Na_2SO_3.

$+2H_2O$. Decomp. by H_2O. (Svensson, **1870**.)

$+11H_2O$. Insol. in cold H_2O, but decomp. by excess. (Étard, C. R. **95**. 138.)

$2Cu_2SO_3, 3Na_2SO_3+29H_2O$. Insol. in H_2O.

$Cu_2SO_3, 5Na_2SO_3+38H_2O$. Decomp. by H_2O.

$Cu_2SO_3, 7Na_2SO_3+19H_2O$. Completely sol. in H_2O, but solutions decomp. on standing. (Svensson.)

"Cuprous sodium *octo*sulphite," $(Cu_2)_3H_{10}Na_{16}S_8O_{32}+43H_2O$. (Étard.)

Cuprocupric potassium sulphite, $3Cu_2SO_3$, $3CuSO_3$, K_2SO_3.

Properties as cuprous potassium sulphite. (Rogojski, J. B. **1851**. 367.)

$2Cu_2SO_3$, $CuSO_3$, $K_2SO_3+5H_2O$. Insol. in H_2O and weak acids. (de St-Gilles.)

Cuprocupric sodium *octo***sulphite, acid,** $Na_8Cu^{II}_{10}(Cu^{I}_2)H_2(SO_4)_8$, $6H_4(SO_4)+5H_2O$.

Sol. in H_2O. (Étard, C. R. **94**. 1422.)

$(Cu^{I}_2)Cu^{II}_2Na_8H_{18}(SO_4)_8$. (Etard.)

Didymium sulphite, $Di_2(SO_3)_3+3H_2O$ or $6H_2O$.

Precipitate. Insol. in H_2O. Sol. in H_2SO_3+Aq, from which it is reprecipitated by heating, redissolving on cooling. (Marignac, A. ch. (3) **38**. 167.)

Erbium sulphite, $Er_2(SO_3)_3+3H_2O$.

Precipitate.

Glucinum sulphite, $GlSO_3$.

Decomp. by H_2O or alcohol. (Krüss and Moraht, B. **23**. 734.)

$GlSO_3$, GlO. Decomp. by H_2O or alcohol. (K. and M.)

$3GlSO_3$, GlO. Sol. in alcohol. (K. and M.)

Aurous potassium sulphite, Au_2SO_3, $3K_2SO_3$.

Very sol. in H_2O; insol. in alcohol. (Haase.)

Auric potassium sulphite, $Au_2O_3, 5K_2O, 8SO_2+5H_2O=5K_2SO_3, Au_2(SO_3)_3+5H_2O$.

Sol. in H_2O with decomp.

Decomp. by acids; insol. in alkalies. (Fremy, A. **79**. 46.)

Aurous sodium sulphite, Au_2SO_3, $3Na_2SO_3+3H_2O$.

Sol. in less than 1 pt. H_2O. Insol. in alcohol. (Haase.)

$+5H_2O$. (Himly.)

Aurous sulphite ammonia, $3Au_2O$, $4SO_2$, $8NH_3+4H_2O$.

Sl. sol. in H_2O with decomp. Decomp. by acids.

Sl. sol. in cold, more easily in hot NH_4OH+

Aq. Decomp. by boiling. (Haase, Zeit. Ch. **1869**. 535.)

Indium sulphite, $2In_2O_3, 3SO_2+8H_2O$.

Insol. in H_2O. (Bayer, A. **158**. 372.)

Iridium sulphite, $Ir_2(SO_3)_3+6H_2O$.

Scarcely sol. in H_2O; easily sol. $HCl+Aq$. (Birnbaum, A. **136**. 179.)

Iridyl sulphite, $(IrO)SO_3+4H_2O$.

Insol. in H_2O. Sol. in HCl or H_2SO_4+Aq. (Birnbaum.)

Iridous potassium sulphite, $IrO, 3K_2O, 5SO_2$ (?).

Sl. sol. in H_2O, more sol. in $KOH+Aq$. Easily sol. in $HCl+Aq$. (Claus, J. pr. **42**. 359.)

Iridous sulphite potassium chloride.

See **Iridosulphite, potassium.**

Iridium sulphite *with* **M_2SO_3**.

See **Iridosulphite, M.**

Ferrous sulphite, $FeSO_3+2\frac{1}{2}H_2O$.

Very sl. sol. in H_2O. Easily sol. in H_2SO_3+Aq. Insol. in alcohol, but sol. therein in presence of SO_2. (Muspratt.)

Ferric sulphite, Fe_2O_3, SO_2+6H_2O.

Very sl. sol. in H_2O. Sol. in acids. (Koene.)

$2Fe_2O_3, 3SO_2$. Deliquescent; decomp. by H_2O into SO_2 and the above comp.

$3Fe_2O_3, SO_2+7H_2O$. Ppt.

Ferroferric potassium sulphite, $FeSO_3, (FeO)_2SO_3, 2K_2SO_3$.

Ppt. (Berglund.)

Ferric potassium sulphite, $K_2O, Fe_2O_3, 3SO_2+2H_2O$.

Sol. in H_2SO_3+Aq. (Koene, Pogg. **63**. 453.)

$Fe_2O_3, 2K_2O, 3SO_2+5H_2O$. Ppt. (Muspratt, Phil. Mag. (3) **30**. 414.)

Lanthanum sulphite, $La_2(SO_3)_3+4H_2O$.

Precipitate. (Cleve.)

Lead sulphite, $PbSO_3$.

Insol. in H_2O. Decomp. by acids. Sl. sol. in H_2SO_3+Aq. (Röhrig, J. pr. (2) **37**. 233.)

Lithium sulphite, $Li_2SO_3+6H_2O$.

Sol. in H_2O; precipitated from aqueous solution by abs. alcohol. (Danson, Chem. Soc. **2**. 205.) Sol. in H_2SO_3+Aq.

$+H_2O$. Sl. sol. in alcohol, and still less sol. in ether. (Röhrig, J. pr. (2) **37**. 225.)

$+2H_2O$. (Röhrig.)

Lithium potassium sulphite, $LiKSO_3+\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Röhrig, J. pr. (2) **37**. 251.)

Lithium sodium sulphite, $6Li_2SO_3, Na_2SO_3+8H_2O$.

Sol. in H_2O. (Röhrig.)

Magnesium sulphite, $MgSO_3+6H_2O$.

Sol. in 20 pts. cold, and in less hot H_2O. (Fourcroy and Vauquelin.)

Sol. in 80 pts. cold, and in 120 pts. boiling H_2O. (Hager, C. C. **1875**. 135.)

More easily sol. in H_2SO_3+Aq.

Precipitated from aqueous solution by alcohol.

$+3H_2O$. (Röhrig, J. pr. (2) **37**. 234.)

Manganous sulphite, $MnSO_3+2H_2O$.

Insol. in H_2O, alcohol, or ether. Easily sol. in acids, also in H_2SO_3+Aq.

$+2\frac{1}{2}H_2O$. (Rammelsberg.)

$+3H_2O$. Sol. in 10,000 pts. cold, and 5000 pts. hot H_2O; more sol. in conc. Mn salts + Aq; sol. in 1000 pts. H_2CO_3+Aq. 100 pts. H_2SO_3+Aq dissolve 15-17 pts. (Gorgeu, C. R. **96**. 341.)

Salt with $2\frac{1}{2}H_2O$ is the only one which exists. (Röhrig, J. pr. (2) **37**. 2.)

Manganous potassium sulphite, $2MnSO_3, K_2SO_3$.

Insol. in H_2O, even when boiling. (Gorgeu, C. R. **96**. 376.)

$MnSO_3, K_2SO_3$. Sol. in H_2O. (Gorgeu.)

Manganous sodium sulphite, $MnSO_3, Na_2SO_3+H_2O$.

Insol. in hot H_2O, but decomp. by cold H_2O. (Gorgeu.)

$4MnSO_3, Na_2SO_3$. Insol. in H_2O. (Gorgeu.)

Mercuric sulphite, $2HgO, SO_2$.

Insol. in H_2O. Sol. in HCl, alkali sulphites with subsequent decomp., and in $KCN+Aq$. (de St-Gilles, A. ch. (3) **36**. 80.)

$HgSO_3$. Decomp. by cold H_2O. (de St-Gilles.)

Does not exist. (Divers and Shimidzu, Chem. Soc. **49**. 553.)

$HgO, 2SO_2+H_2O$. Sol. in H_2O, but decomp. by boiling. (de St-Gilles.) Exists only in aqueous solution. (Divers and Shimidzu.)

Mercuromercuric sulphite, $Hg_3(SO_3)_2+2H_2O=Hg_2SO_3, HgSO_3$.

Very efflorescent. Insol. in H_2O. Decomp. by hot H_2O. Insol. in dil. HNO_3 or H_2SO_4+Aq.

$+4H_2O$. Very efflorescent.

*Hypo***mercurosic sulphite**, $Hg_4(SO_3)_2+H_2O$.

Insol. in H_2O, but easily decomp. on standing therewith. Almost absolutely insol. in dil. HNO_3 or H_2SO_4+Aq. (Divers and Shimidzu.)

Mercuric *oxy***sulphite**, $Hg(SO_2OHgO)_2Hg+H_2O$.

Insol. in H_2O. Decomp. by hot H_2O. Insol. in dil. HNO_3 or H_2SO_4+Aq. Sol. in H_2SO_3+Aq. (Divers and Shimidzu.)

Mercuric potassium sulphite, $HgSO_3, K_2SO_3+H_2O$.

Sl. sol. in cold H_2O. Decomp. on boiling. (de St-Gilles, A. ch. (3) **36**. 90.)

Mercuric silver sulphite, $HgSO_3, Ag_2SO_3+2H_2O$.

Decomp. rapidly; insol. in H_2O. (Barth, Z. phys. Ch. **9**. 195.)

Mercuric sodium sulphite, $HgSO_3, Na_2SO_3+H_2O$.

Sol. in H_2O. (de St-Gilles.)

Sol. in 25 pts. cold H_2O, and decomp. on heating. (Divers and Shimidzu.)

$+2H_2O = Na_2(SO_3)_2Hg + 2H_2O$. (Barth, Z. phys. Ch. **9.** 193.)

$2HgSO_3, Na_2SO_3 + H_2O$. Much more sol. in H_2O than the above comp. especially on heating. (de St-Gilles.)

Does not exist. (Divers and Shimidzu.)

Mercuric strontium sulphite, $HgSO_3, SrSO_3 + 2H_2O$.

Ppt. (Barth.)

Nickel sulphite, $NiSO_3 + 4H_2O$.

Insol. in H_2O. Sol. in HCl+Aq with evolution of SO_2. (Muspratt, A. **50.** 259.)

$+6H_2O$. Insol. in H_2O. Sol. in H_2SO_3+Aq. (Rammelsberg, Pogg. **67.** 391.)

Nickel sulphite ammonia, $NiSO_3, 3NH_3 + 3H_2O$.

Sol. in little H_2O. Decomp. by much H_2O or heat. (Rammelsberg, Pogg. **67.** 245.)

Osmious sulphite, $OsSO_3$.

Insol. in H_2O. Easily sol. in HCl+Aq without evolution of SO_2. Very slowly decomp. by KOH+Aq. (Claus.)

Osmious potassium sulphite, $OsSO_3, 2K_2SO_3, 2KHSO_3 + 4H_2O$.

Nearly insol. in H_2O.

Osmious potassium sulphite chloride, $OsO, 2SO_2, 6KCl$.

Easily sol. in H_2O.

Palladious sodium sulphite, $PdSO_3, 3Na_2SO_3 + 2H_2O = Na_6Pd(SO_3)_4 + 2H_2O$.

Sol. in hot H_2O. Sol. in NaOH+Aq or H_2SO_3+Aq. (Wöhler and Frerichs, A. **174.** 199.)

Platinous sulphite, $PtO_2, 2SO_2$.

Easily sol. in H_2O or alcohol. (Döbereiner, J. pr. **15.** 315.)

Formula is $PtSO_3$. (Gmelin.)

$PtSO_3, H_2SO_3$. (Birnbaum, A. **139.** 172.)

Platinous sulphite *with* M_2SO_3.

See **Platosulphite, M.**

Platinum sulphite ammonium chloride.

See **Chloroplatosulphite, ammonium.**

Platinic potassium sulphite, $PtO_2, SO_2, K_2SO_3 + H_2O$.

Sol. in KOH+Aq. (Birnbaum, A. **139.** 173.)

Platinic sodium sulphite, $PtO_2, SO_2, 2Na_2SO_3 + 2H_2O$.

Sol. in H_2O. (Birnbaum.)

Potassium sulphite, $K_2SO_3 + 2H_2O$.

Somewhat deliquescent. Sol. in 1 pt. cold, and still less hot H_2O. (Fourcroy and Vauquelin, A. ch. **24.** 254.)

Very slightly soluble in alcohol. Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Potassium hydrogen sulphite, $KHSO_3$.

Sol. in H_2O. Insol. in absolute alcohol.

Potassium *pyro*sulphite, $K_2S_2O_5$.

Slowly sol. in H_2O. Very sl. sol. in alcohol; insol. in ether. (Muspratt, A. **50.** 259.)

Potassium rhodium sulphite, $3K_2SO_3, Rh_2(SO_3)_3 + 6H_2O$.

See **Rhodosulphite, potassium.**

Potassium sodium sulphite, $KNaSO_3$.

Sol. in H_2O. (Spring, B. **7.** 1161.)

+1, and $2H_2O$. (Schwicker, B. **22.** 1731.)

Isomeric salts, KSO_3Na and $NaSO_3K$. (Barth Z. phys. Ch. **9.** 176.)

Potassium sodium hydrogen sulphite, $KNa_2H(SO_3)_2 + 4H_2O$.

Easily sol. in H_2O; 100 pts. H_2O dissolve 69 pts. salt at 15°. (Schwicker, B. **22.** 1731.)

$K_2NaH(SO_3)_2 + 3H_2O$. (Schwicker.)

Potassium uranyl sulphite, $K(UO_2)(OH)SO_3$.

Insol. in H_2O, but sol. in H_2SO_3+Aq. (Scheller.)

Potassium zinc sulphite, $K_2SO_3, 3ZnSO_3 + 7\frac{1}{2}H_2O$.

Sol. in H_2O with decomp. (Berglund, Acta Lund. **1872.**)

Rhodium sulphite, $Rh_2(SO_3)_3 + 6H_2O$.

Sol. in H_2O. Insol. in alcohol. (Claus.)

Rhodium sodium sulphite.

See **Rhodosulphite, sodium.**

Samarium sulphite, $Sm_2(SO_3)_3$.

Amorphous precipitate. (Cleve.)

Selenium sulphite, $SeSO_3$.

Correct composition for "selenium sulphoxide." (Divers, Chem. Soc. **49.** 583.)

Silver sulphite, Ag_2SO_3.

Very sl. sol. in cold H_2O. Decomp. on heating. Easily sol. in NH_4OH+Aq, and alkali sulphites+Aq. Insol. in H_2SO_3+Aq. Decomp. by strong acids, but not by acetic acid. (Berthier, A. ch. (3) **7.** 82.)

Easily sol. in alkali thiosulphates +Aq. (Herschel.)

Practically insol. in HNO_3+Aq or dil. $AgNO_3$+Aq, also in H_2SO_3+Aq. (Divers, Chem. Soc. **49.** 579.)

Silver sodium sulphite, $Ag_2SO_3, Na_2SO_3 + 4H_2O$.

Decomp. by H_2O. (Svensson, B. **4.** 714.)

Sodium sulphite Na_2SO_3.

100 pts. dissolve at 0°, 14·1 pts.; at 20°, 25·8 pts.; at 40°, 49·5° pts. Na_2SO_3. (Kremers, Pogg. **99.** 50.) Maximum solubility is at 33°. (Mitscherlich.)

Insol. in alcohol.

Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

$+7H_2O$. Decomp. slowly on air.

Sol. in 4 pts. H_2O at 15° with absorption of heat (Dumas), and in 1 pt. boiling H_2O (Fourcroy).

$+10H_2O$. Efflorescent. Somewhat less sol. than above salt. (Muspratt.)

Sodium hydrogen sulphite, $NaHSO_3$.

More difficultly sol. in H_2O than $NaHCO_3$, and is precipitated by alcohol from aqueous solution. (Muspratt.)

$+4H_2O$. (Clark.)

Sodium *pyro*sulphite, $Na_2S_2O_5$.
Decomp. gradually on the air.

Sodium uranyl sulphite, $Na(UO_2)(OH)SO_3$.
Sl. sol. in H_2O. More sol. in H_2SO_3+Aq than the K salt. (Scheller.)

Sodium zinc sulphite, $Na_2SO_3, 3ZnSO_3+7\frac{1}{2}H_2O$.
Sol. in H_2O with decomp. (Berglund, Acta Lund, **1872.**)

Sodium sulphite silver chloride, $3Na_2SO_3, AgCl+21H_2O$.
Sol. in H_2O. (Svensson.)

Strontium sulphite, $SrSO_3$.
Precipitate. Almost insol. in H_2O. Sol. in H_2SO_3+Aq. (Muspratt.)
Abundantly sol. in H_2SO_3+Aq. (Röhrig.)

Tellurium sulphite, $TeSO_3$.
Correct composition of "tellurium sulphoxide." (Divers, Chem. Soc. **49.** 583.)

Thallous sulphite, Tl_2SO_3.
Sl. sol. in cold, easily in hot H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 229.)
100 pts. H_2O dissolve 3·34 pts. at 15·5°. Easily sol. in hot H_2O; insol. in alcohol. (Seubert and Elken, Z. anorg. **2.** 434.)

Thorium sulphite, $Th(SO_3)_2+H_2O$.
Precipitate. (Cleve.)

Stannous sulphite, $5SnO, 2SO_2+xH_2O$.
Ppt. Partly sol. in H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 249.)
$+20H_2O$. (Röhrig.)
$8SnO, 2SO_2+20H_2O$.
$11SnO, 2SO_2+20H_2O$. (Röhrig.)

Uranous sulphite, basic, $U(OH)_2SO_3+H_2O$.
Insol. in H_2O. Easily sol. in acids. Sol. in H_2SO_3+Aq, but is soon decomp. (Rammelsberg.)

Uranyl sulphite, $(UO_2)SO_3+4H_2O$.
Insol. in H_2O. Sol. in H_2SO_3+Aq or alcoholic solution of SO_2. (Röhrig, J. pr. (2) **37.** 240.)

Yttrium sulphite, $Y_2(SO_3)_3+3H_2O$.
Sl. sol. in H_2O. (Cleve.)

Zinc sulphite, basic, $2ZnSO_3, 3Zn(OH)_2$.
(Seubert, Arch. Pharm. **229.** 321.)
$ZnSO_3, Zn(OH)_2+H_2O$. (Seubert.)

Zinc sulphite, $ZnSO_3+2$, and $2\frac{1}{2}H_2O$.
Very sl. sol. in H_2O. 100 pts. H_2O dissolve 0·16 pt. $ZnSO_3+2H_2O$. (Henston and Tichborne, Brit. Med. J. **1890.** 1063.)
Easily sol. in H_2SO_3+Aq. (Koene.)
Sol. in NH_4OH+Aq.
Insol. in alcohol.
Decomp. into basic salt by boiling H_2O. (Seubert, Arch. Pharm. **229.** 1.)

Zinc sulphite ammonia, $ZnSO_3, NH_3$.
Decomp. by H_2O. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **67.** 255.)

Zirconium sulphite.
Insol. in H_2O. Somewhat sol. in H_2SO_3+Aq, from which it is repptd. on boiling. Sol. in $(NH_4)_2SO_3+Aq$, from which Zr hydroxide is pptd. on boiling. (Berzelius.)

Sulphuryl bromide, SO_2Br_2.
(Odling, Chem. Soc. **7.** 2.)
Does not exist. (Sestini, Bull. Soc. **10.** 226; Melsens, C. R. **76.** 92; Michaelis.)

Sulphuryl chloride, SO_2Cl_2.
Decomp. by H_2O and alcohol.

***Di*sulphuryl chloride (*Pyro*sulphuryl chloride),** $S_2O_5Cl_2$.
Decomp. slowly with H_2O. (Rose, Pogg. **44.** 291.)
Sol. in CCl_4, $CHCl_3$; miscible with liquid SO_3.

Sulphuryl hydroxyl chloride,

$$SO_3HCl=\begin{matrix}HO\\Cl\end{matrix}SO_2.$$

Decomp. on moist air, and violently with H_2O. Not miscible with CS_2. Decomp. with alcohol.

Sulphuryl titanium chloride, $SO_3, TiCl_4=TiCl_3OSO_2Cl$.
Slowly deliquescent. (Clausnitzer, B. **11.** 2011.)

***Di*sulphuryl chloride stannic oxychloride,** $5S_2O_5Cl_2, 4SnOCl_2$.
Sol. in a little H_2O, but decomp. by more H_2O. (Rose, Pogg. **44.** 320.)

Sulphuryl hydroxyl fluoride, HSO_3F.
Violently decomp. by H_2O. (Thorpe and Kirwan, Z. anorg. **3.** 63.)

Sulphuryl *per*oxide, SO_4.
See **Sulphur *hept*oxide.**

Sulphydroxyl.
See **Sulphhydroxyl.**

Tantalic acid, $H_4Ta_2O_7$ (?).
Sol. in HF (Rose), and $KH_3(C_2O_4)_2+Aq$ (Gahn, Schw. J. **16.** 437). At the instant of precipitation is sol. in various acids. (Rose.)

Aluminum tantalate.
Insol. in H_2O. (Berzelius.)

Ammonium *hexa*tantalate, $(NH_4)_2H_6Ta_6O_{19}+H_2O$.
Somewhat sol. in H_2O. (Rose, Pogg. **102.** 57.)

Barium *hexa*tantalate, $Ba_4Ta_6O_{19}+6H_2O$.
Sl. sol. in H_2O. (Rose.)

Ferrous tantalate, $Fe(TaO_3)_2$.
Min. *Tantalite.*
$5FeO, 4Ta_2O_5$. Min. *Tapiolite.*

Magnesium *hexa*tantalate, $Mg_4Ta_6O_{19}+9H_2O$.
Ppt. (Rose, Pogg. **102.** 61.)
$4MgO, Ta_2O_5$. Insol. in H_2O. (Joly, C. R. **81.** 266.)

Mercurous tantalate, $5Hg_2O, 4Ta_2O_5+5H_2O$.

Decomp. by warm HNO_3+Aq (1·21 sp. gr.) with separation of Ta_2O_5. (Rose, Pogg. **102.** 64.)

Potassium tantalate, $KTaO_3$.

Insol. in H_2O. Sol. in KOH+Aq. (Marignac, A. ch. (4) **9.** 249.)

Potassium *hexa*tantalate, $K_8Ta_6O_{19}+16H_2O$.

Sol. without decomp. in moderately warm H_2O. Decomp. by boiling. (Marignac, A. ch. (4) **9.** 259.)

Silver tantalate, $4Ag_2O, 3Ta_2O_5$.

Completely sol. in NH_4OH+Aq. HNO_3+Aq dissolves Ag_2O, and Ta_2O_5 separates out. (Rose, Pogg. **102.** 64.)

Sodium tantalate, $NaTaO_3$.

Insol. in H_2O. (Rose.)

Sodium *hexa*tantalate, $Na_8Ta_6O_{19}+25H_2O$.

1 pt. salt. dissolves in 493 pts. H_2O at 13·5°, and in 162 pts. at 100°. Very slightly sol. in alcohol. Insol. in alkaline solutions. (Rose.)

Tantalum, Ta.

Probably has not been obtained in an absolutely pure state.

Not attacked by HCl, HNO_3, aqua regia, or hot conc. H_2SO_4. Easily sol. in a mixture of HNO_3 and HF (Berzelius, Pogg. **4.** 6; Rose). Also sol. in HF alone (Berzelius).

Not attacked by alkali hydrates+Aq.

Tantalum bromide, $TaBr_5$.

Decomp. by H_2O. (Rose.)

Tantalum chloride, $TaCl_5$.

Takes up H_2O from the air without deliquescing. Decomp. by H_2O. Sol. in H_2SO_4. Sol. in cold HCl+Aq to a cloudy liquid, which gelatinises after a time. Not completely sol. in boiling HCl+Aq, and the solution does not gelatinise by the subsequent addition of water, but all goes into solution. Partly sol. in KOH+Aq. Insol. in K_2CO_3+Aq. Sol. in absolute alcohol.

Tantalum fluoride, TaF_5.

Known only in solution in HF, which may contain a fluotantalic acid, H_2TaF_7.

With MF. *See* **Fluotantalate, M.**

Tantalum nitride, TaN.

Not sol. in any acids, except a mixture of HF and HNO_3. (Rose, Pogg. **100.** 146.)

Ta_3N_5. (Joly, Bull. Soc. (2) **25.** 506.)

Tantalum hydroxide, Ta_2O_5, xH_2O.

See **Tantalic acid.**

Tantalum *di*oxide, Ta_2O_2 (?).

Sol. in HF with evolution of hydrogen. (Hermann, J. pr. (2) **5.** 69.)

Tantalum *tetr*oxide, Ta_2O_4.

Not attacked by any acid, not even a mixture of HNO_3 and HF. (Berzelius, Pogg. **4.** 20.)

Tantalum *pent*oxide, Ta_2O_5.

Insol. in any acid, not even boiling H_2SO_4 or in HF. (Berzelius.)

Sol. in fused $KHSO_4$, 10 pts. being necessary to dissolve 1 pt. Ta_2O_5.

Tantalum sulphide, Ta_2S_4.

Not attacked by HCl+Aq. Oxidised by boiling with HNO_3+Aq, more rapidly with aqua regia. Attacked by H_2SO_4 on heating. Not completely sol. in HF or a mixture of HF and HNO_3.

Telluretted hydrogen, TeH_2.

See **Hydrogen telluride.**

Telluric acid, H_2TeO_4.

Insol. in H_2O, cold conc. HCl, hot HNO_3, or boiling KOH+Aq, but when heated with H_2O is gradually converted into $H_2TeO_4+2H_2O$ and dissolved.

$+2H_2O$. Very slowly sol. in cold H_2O, but sol. in hot H_2O in every proportion. Insol. in absolute alcohol; sol. in dil. alcohol according to the amount of H_2O present. Sol. in acids and alkalies. Insol. in alcohol or ether.

Tellurates.

Neutral alkali salts are sol. in H_2O; the acid salts are only sl. sol. therein, but dissolve in HCl+Aq.

Aluminum tellurate.

Ppt. Sol. in excess of aluminum salts+Aq. (Berzelius.)

Ammonium tellurate, $(NH_4)_2TeO_4$.

Slowly but completely sol. in H_2O. Sl. sol. in NH_4OH+Aq or NH_4Cl+Aq. Sl. sol. in alcohol. (Berzelius.)

$(NH_4)_2O, 2TeO_3$. Sl. sol. in H_2O, but more sol. than the corresponding K salt.

$(NH_4)_2O, 4TeO_3$. Very sl. sol. in H_2O. Insol. in alcohol. (Berzelius.)

Barium tellurate, $BaTeO_4+3H_2O$.

Sl. sol. in cold, more in boiling H_2O. Easily sol. in HNO_3+Aq. (Berzelius.)

$BaH_2(TeO_4)_2+2H_2O$. More sol. in H_2O than $BaTeO_4$. Decomp. by H_2O. (Berzelius.)

$BaO, 4TeO_3$. More sol. in H_2O than either $BaTeO_4$ or $BaH_2(TeO_4)_2$. (Berzelius.)

Bismuth tellurate, $Bi_2TeO_6+2H_2O$.

Min. *Montanite.* Sol. in HCl+Aq with evolution of Cl.

Cadmium tellurate, $CdTeO_4$.

Ppt. Sol. in HCl+Aq. (Oppenheim.)

Calcium tellurate, $CaTeO_4$.

Ppt. Sol. in hot H_2O. (Berzelius.)

Chromic tellurate, $Cr_2(TeO_4)_3$.

Ppt. Sol. in excess of Cr salts+Aq.

Cobaltous tellurate.

Ppt. (Berzelius.)

Cupric tellurate, $CuTeO_4$.

Ppt. (Berzelius.)

$CuO, 2TeO_3$. Ppt. (B.)

Glucinum tellurate, $GlTeO_4$.

Insol. in H_2O.

Ferrous tellurate, $FeTeO_4$.
Ppt. Min. *Ferrotellurate.*

Ferric tellurate, $Fe_2(TeO_4)_3$.
Ppt. Sol. in ferric salts + Aq. (Berzelius.)

Lead tellurate, basic.
Not completely insol. in H_2O.

Lead tellurate, $PbTeO_4$.
Somewhat sol. in H_2O.
$PbO, 2TeO_3$. More sol. than $PbTeO_4$.
$PbO, 4TeO_3$. Sl. sol. in H_2O. Sol. in HNO_3 + Aq, less sol. in $HC_2H_3O_2$ + Aq. (Berzelius.)

Lithium tellurates.
Resemble K salts.

Magnesium tellurate, $MgTeO_4$.
Ppt. More sol. in H_2O than the Ba, Sr, or Ca salts.
$MgTe_2O_7$. More sol. in H_2O than $MgTeO_4$.

Manganous tellurate.
Ppt.

Mercurous tellurate, Hg_2TeO_4.
Ppt. Min. *Magnolite.*

Mercuric tellurate.
Ppt. (Berzelius.)

Nickel tellurate.
Ppt.

Potassium tellurate, $K_2TeO_4 + 5H_2O$.
Deliquesces. Sol. in H_2O. Very sl. sol. in H_2O containing KOH.
Insol. in alcohol. (Berzelius.)
$K_2O, 2TeO_3$. Insol. in H_2O, acids, or alkalies. (B.)
$KHTeO_4 + \frac{3}{2}H_2O$. Sl. sol. in cold, more sol. in hot H_2O. (Berzelius.)
$K_2O, 4TeO_3$. Insol. in H_2O, HCl, or HNO_3 + Aq. Sol. by long heating with conc. HNO_3 + Aq.
$KHTeO_4, H_2TeO_4 + \frac{1}{2}H_2O$. Sl. sol. in H_2O.

Silver tellurate, $3Ag_2O, TeO_3$.
Sol. in NH_4OH + Aq.
$3Ag_2O, 2TeO_3$. Insol. in boiling H_2O.
Ag_2TeO_4. Decomp. by H_2O into $3Ag_2O, TeO_3$. Sol. in NH_4OH + Aq.
$Ag_2Te_2O_7$. Ppt.
$Ag_2O, 4TeO_3$. Ppt.

Sodium tellurate, $Na_2TeO_4 + 2H_2O$.
Very sl. sol. in hot or cold H_2O. When heated to drive off $2H_2O$ becomes insol. in H_2O, but sol. in dil. HNO_3 + Aq. (Berzelius.)
$Na_2Te_2O_7 + 4H_2O = NaHTeO_4 + 1\frac{1}{2}H_2O$. Slowly but completely sol. in H_2O. Sl. sol. in $NaC_2H_3O_2$ + Aq. Insol. in alcohol. (Berzelius.)
$Na_2O, 4TeO_3$. Insol. in H_2O, acids, or alkalies, except by long boiling with HNO_3 + Aq.
$+ xH_2O$. (α) Slowly sol. in H_2O. (β) Insol. even in boiling H_2O.

Strontium tellurates.
Resemble Ca salts.

Thallium tellurate.
Ppt. (Clarke, Sill. Am. J. (3) **16**. 401.)

Thorium tellurate.
Ppt. Insol. in excess of thorium salts + Aq.

Uranium tellurate, $U_2(TeO_4)_3$ (?).
Ppt. Insol. in H_2O or $UO_2(NO_3)_2$ + Aq.

Yttrium tellurate.
Ppt. Insol. in H_2O or Yt salts + Aq.

Zirconium tellurate.
Ppt. (Berzelius.)

Tellurium, Te.
Insol. in H_2O or HCl + Aq. Sl. sol. in hot conc. H_2SO_4, but separates out on cooling. Sol. in boiling conc. H_2SO_4. Easily oxidised by HNO_3 or aqua regia. Sol. in boiling very conc. KOH + Aq, separating out again on cooling.
Not attacked by boiling conc. HNO_3 + Aq, according to Hartung-Schwartzkoff (Ann. Min. (4) **19**. 345).
Sol. in warm conc. KCN + Aq.
100 pts. methylene iodide dissolve 0·1 pt. Te at 12°. (Retgers, Z. anorg. **3**. 343.)

Tellurium *di***bromide,** $TeBr_2$.
Decomp. on air or by H_2O. (Rose, Pogg. **21**. 443.)

Tellurium *tetra***bromide,** $TeBr_4$.
Sol. in a little, but decomp. by much H_2O.
$+ H_2O$. Very deliquescent.

Tellurium *di***chloride,** $TeCl_2$.
Decomp. on air, or by H_2O or HCl + Aq. (Rose, Pogg. **21**. 443.)

Tellurium *tetra***chloride,** $TeCl_4$.
Extremely deliquescent. Decomp. by cold H_2O, with separation of oxychloride and tellurous acid. Sol. in hot H_2O with decomp. Sol. in dil. HCl + Aq without decomp. (Rose, Pogg. **21**. 443.)

Tellurium chloride *with* **MCl.**
See **Chlorotellurate, M.**

Tellurium chloride ammonia, $TeCl_4, 4NH_3$.
Not deliquescent. Decomp. by H_2O. (Espenschied, J. pr. **80**. 480.)

Tellurium *tetra***fluoride,** $TeF_4 + H_2O$.
(Högbom, Bull. Soc. (2) **35**. 60.)

Tellurium *di***iodide,** TeI_2.
Insol. in H_2O. (Rose, Pogg. **21**. 443.)

Tellurium *tetra***iodide,** TeI_4.
Insol. in cold, decomp. by hot H_2O or alcohol. Sol. in HI, but only sl. sol. in MI + Aq. (Berzelius.)

Tellurium *mon***oxide,** TeO.
Sl. sol. in cold dil. HCl or H_2SO_4 + Aq. Easily oxidised by HNO_3 + Aq or aqua regia. Decomp. immediately by boiling conc. HCl + Aq. Slowly decomp. by KOH + Aq. (Divers and Shimosé, Chem. Soc. **35**. 563.)

Tellurium *di*oxide, TeO_2.

Very sl. sol. in H_2O. Sl. attacked by acids. Sl. sol. in NH_4OH or alkali carbonates + Aq. Easily sol. in NaOH or KOH + Aq. Not sol. in less than 150,000 pts. H_2O. Easily sol. in warm dil. HNO_3 + Aq. Sol. in warm H_2SO_4 + Aq. (Klein and Morel, Bull. Soc. (2) **43.** 203.)

Min. *Tellurite.*

Tellurium *di*oxide hydrobromic acid, TeO_2, 3HBr.

(Ditte, C. R. **83.** 336.)

Tellurium *di*oxide hydrochloric acid, TeO_2, 2HCl.

(Ditte, C. R. **83.** 336.)

TeO_2, 3HCl. (Ditte.)

Tellurium *tri*oxide, TeO_3.

Insol. in cold or hot H_2O, cold HCl + Aq, or cold or hot HNO_3 + Aq. Insol. in moderately conc. KOH + Aq, but, when the KOH + Aq is very conc., is sol. if boiling.

Tellurium oxybromide.

Insol. in H_2O. (Ditte, A. ch. (5) **10.** 82.)

Tellurium oxychloride, $TeOCl_2$.

Insol. in H_2O. (Ditte.)

Tellurium *di*sulphide, TeS_2.

Insol. in H_2O or dil. acids. Sol. in alkali hydrates or sulphides + Aq.

CS_2 dissolves out S, so that the substance is probably a mixture. (Becker, A. **180.** 257.)

Tellurium *tri*sulphide, TeS_3.

Insol. in H_2O. Sol. in K_2S + Aq.

Tellurium sulphoxide, $TeSO_3$.

Decomp. by H_2O. Sol. in H_2SO_4. (Weber, J. pr. (2) **25.** 218.)

Is tellurium sulphite. (Divers, Chem. Soc. **49.** 583.)

Tellurous acid, H_2TeO_3.

Appreciably sol. in H_2O and acids. Sol. in alkali hydrates or carbonates + Aq.

Tellurites.

The neutral and acid tellurites of the alkali metals are sol. in H_2O. Ba, Sr, Ca, and Mg tellurites are sl. sol., and the other salts insol. in H_2O. Most tellurites are sol. in HCl + Aq.

Aluminum tellurite.

Ppt. Insol. in Al salts + Aq. (Berzelius.)

Ammonium tellurite, $(NH_4)HTeO_3$, $H_2TeO_3+3\frac{1}{2}H_2O$.

Sol. in H_2O, from which it is precipitated by NH_4Cl + Aq or alcohol. (Berzelius.)

Barium tellurite, $BaTeO_3$.

Sl. sol. in H_2O when prepared in the moist way. (Berzelius.)

BaO, $4TeO_2$.

Cadmium tellurite.

Ppt. Sol. in HNO_3, and HCl + Aq. (Oppenheim.)

Calcium tellurite, $CaTeO_3$.

Sl. sol. in cold, more sol. in hot H_2O. (Berzelius.)

CaO, $4TeO_2$.

Chromium tellurite.

Ppt. Sol. in excess of chromic salts + Aq.

Cobaltous tellurite.

Ppt.

Cupric tellurite.

Insol. in H_2O. (Berzelius.)

Glucinum tellurite.

Insol. in H_2O.

Ferrous tellurite.

Ppt.

Ferric tellurite.

Ppt.

Lead tellurite, $PbTeO_3$.

Ppt. Easily sol. in acids. (Berzelius.)

Lithium tellurite, Li_2TeO_3.

Sol. in H_2O. (Berzelius.)

Li_2O, $2TeO_2$. Decomp. by cold H_2O into Li_2TeO_3 and Li_2O, $4TeO_2$. (B.)

Li_2O, $4TeO_2$. Sol. in hot, much less in cold H_2O. (B.)

Magnesium tellurite, $MgTeO_3$.

Precipitate. Much more sol. in H_2O than the Ba, Sr, or Ca salt. (Berzelius.)

Manganous tellurite.

Ppt.

Mercurous tellurite.

Ppt.

Mercuric tellurite.

Ppt.

Nickel tellurite.

Ppt.

Potassium tellurite, K_2TeO_3.

Not deliquescent. Slowly sol. in cold, more quickly in boiling H_2O. (Berzelius.)

K_2O, $2TeO_2$. Completely sol. in boiling H_2O, from which K_2O, $4TeO_2$ crystallises. (B.)

K_2O, $4TeO_2+4H_2O$. Decomp. by cold H_2O into K_2O, TeO_2, and K_2O, $2TeO_2$, which dissolve, and H_2TeO_3, which is insol. (B.)

Potassium *hexa*tellurite, K_2O, $6TeO_2+2H_2O$.

Not decomp. by, but sl. sol. in H_2O. (Klein and Morel, C. R. **100.** 1140.)

Silver tellurite, Ag_2TeO_3.

Ppt. Sol. in NH_4OH + Aq. (Berzelius.)

$AgHTeO_3$. Insol. in H_2O. Sol. in HNO_3 + Aq. (Rose, Pogg. **18.** 60.)

Sodium tellurite, Na_2TeO_3.

Slowly sol. in cold, more quickly in hot H_2O. Precipitated from aqueous solution by alcohol. (Berzelius.)

Na_2O, $2TeO_2$. Decomp. by H_2O as K salt. (B.)

Na_2O, $4TeO_2+5H_2O$. As above. (B.)

Strontium tellurite, $SrTeO_3$.

Resembles Ba salt.

$SrH_2Te_4O_{10}$. Very sl. sol. in H_2O, more easily in HNO_3+Aq.

Thorium tellurite.

Precipitate. Insol. in H_2O or Th salts+Aq.

Stannous tellurite.

Pptd. in presence of 60,000 pts. H_2O. (Fischer.)

Uranium tellurite, $U_2(TeO_3)_3$.

Ppt. Insol. in U salts+Aq.

Yttrium tellurite.

Precipitate.

Zinc tellurite, $ZnTeO_3$.

Ppt.

Zirconium tellurite.

Ppt.

Terbium, Tr.

Metal has not been isolated.

Has been decomp. into two or more elements by Krüss (Z. anorg. **4.** 27).

Terbium hydroxide.

Sol. in dilute acids. Decomposes NH_4 salts+Aq.

Terbium oxide, Tr_2O_3.

Sol. in dil. acids, even after ignition.

Tetramine chromium compounds.

See—

Bromotetramine chromium compounds.
Chlorotetramine chromium compounds.
Iodotetramine chromium compounds.

Tetramine cobaltic compounds, $Co(NH_3)_4X_3$.

See—

Bromotetramine cobaltic compounds.
Carbonatotetramine cobaltic compounds.
Chlorotetramine cobaltic compounds.
Croceocobaltic compounds.
Fuscocobaltic compounds.
Flavocobaltic compounds.
Iodotetramine cobaltic compounds.
Nitratotetramine cobaltic compounds.
Praseocobaltic compounds.
Roseotetramine cobaltic compounds.
Sulphatotetramine cobaltic compounds.

See also under octamine cobaltic salts for many tetramine salts as yet unclassified.

Tetramine cobaltic nitrite *with* **MNO$_2$**, $Co_2(NH_3)_4(NO_2)_6$, $2MNO_2$.

See **Diamine cobaltic nitrite.**

Tetrathionic acid, $H_2S_4O_6$.

Known only in aqueous solution.

Dil. solution can be boiled without decomp. Conc. solution decomp. by boiling.

Addition of H_2SO_4 or HCl makes solution more stable. (Fordos and Gélis, C. R. **15.** 920.)

Tetrathionates.

Tetrathionates are all easily sol. in H_2O, but insol. in alcohol.

Barium tetrathionate, $BaS_4O_6+2H_2O$.

Very sol. in H_2O, but precipitated by addition of alcohol.

Cadmium tetrathionate.

Deliquescent. Solution in H_2O gradually decomposes. (Kessler, Pogg. **74.** 249.)

Copper tetrathionate.

Sol. in H_2O. (Fordos and Gélis.)

Lead tetrathionate, $PbS_4O_6+2H_2O$.

Sol. in H_2O.

Manganous hydrogen tetrathionate, $MnH_2(S_4O_6)_2$.

Deliquescent. Very sol. in H_2O and alcohol. (Curtius and Henkel, J. pr. (2) **37.** 148.)

Potassium tetrathionate, $K_2S_4O_6$.

Soluble in H_2O. Insol. in alcohol.

Sodium tetrathionate, $Na_2S_4O_6$.

Sol. in H_2O. Precipitated therefrom by a great excess of alcohol. (Kessler, J. pr. **95.** 13.)

$+2H_2O$. (Berthelot, A. ch. (6) **17.** 450.)

Strontium tetrathionate, $SrS_4O_6+6H_2O$.

Sol. in H_2O. (Kessler, Pogg. **74.** 255.)

More sol. in H_2O than Ba salt.

Zinc tetrathionate.

Sol. in H_2O. (Fordos and Gélis.)

Zinc hydrogen tetrathionate, $ZnH_2(S_4O_6)_2$.

Extremely sol. in H_2O and alcohol. (Curtius and Henkel, J. pr. (2) **37.** 147.)

Thallic acid.

Potassium thallate.

Known only in aqueous solution. (Carstanjen, J. pr. **101.** 55.)

Does not exist. (Lepsius, Chem. Ztg. **1890.** 1327.)

Thallium, Tl.

Not attacked by pure H_2O. Easily sol. in dil. H_2SO_4 or HNO_3+Aq. Difficultly sol. in HCl+Aq. Absolute alcohol dissolves considerable quantity in a short time, also methyl alcohol, and acetic ether. (Böttger.)

Not easily attacked by HF+Aq. (Kuhlmann.)

Thallium arsenide, TlAs.

Decomp. by H_2SO_4. (Carstanjen.)

Thallous bromide, TlBr.

Nearly insol. in cold, sl. sol. in boiling H_2O. (Willm, Bull. Soc. (2) **2.** 89.)

1 pt. H_2O dissolves 0·00869 pt. TlBr at 68·5°. (Noyes, Z. phys. Ch. **6.** 248.)

Thallic bromide, $TlBr_3$.

Deliquescent. Easily sol. in H_2O and alcohol. (Willm.)

Thallothallic bromide, 3TlBr, $TlBr_3$.

Decomp. by H_2O into TlBr and $TlBr_3$.

TlBr, $TlBr_3$. Decomp. by boiling H_2O. (Willm.)

Thallic bromide ammonia, $TlBr_3, 3NH_3$.

Decomp. by H_2O.

Thallous chloride, $TlCl$.

Sol. in pts. H_2O at t°, according to H= Hebberling; C=Crookes; L=Lamy.

0°	15°	16°	16·5°	
504	283·4	377	359	pts. H_2O,
H	C	H	H	

100°	100°	100°	
about 50	52·5	63	pts. H_2O.
L	C	H	

1 pt. H_2O dissolves 0·0161 pt. $TlCl$ at 25°. (Noyes, Z. phys. Ch. **6.** 249.)

Much less sol. in H_2O containing HCl or HNO_3.

Nearly insol. in NH_4OH+Aq.

Insol. in alcohol.

Easily sol. in hot $HgCl_2$+Aq. (Carstanjen.)

Solubility in HCl+Aq. 1 pt. dissolves pts. $TlCl$.

g. HCl added	Pts. TlCl	g. HCl added	Pts. TlCl
0	0·01610	0·1468	0·00316
0·0283	0·00836	1·000	0·00200
0·0560	0·00565	...	...

(Noyes, Z. phys. Ch. **6.** 249.)

Thallic chloride, $TlCl_3+H_2O$.

Deliquescent, and very easily sol. in H_2O. (Werther.)

$+7\frac{1}{2}H_2O$. Deliquescent. (Werther.)

Thallothallic chloride, $3TlCl, TlCl_3$.

1 pt. dissolves in pts. H_2O at t°, according to C=Crookes; H=Hebberling; L=Lamy.

15°	17°	100°	100°	
380·1	346	52·9	20-25	pts. H_2O.
C	H	C	L	

Sl. decomp. by dissolving. (Lamy.)

$TlCl, TlCl_3$. Sl. deliquescent. (Lamy.)

Thallic chloride ammonia, $TlCl_3, 3NH_3$.

Decomp. by H_2O. Sol. in HCl+Aq. (Willm.)

Thallous fluoride, TlF.

Sol. in $1\frac{1}{4}$ pts. H_2O at 15°, and in much less hot H_2O. Difficultly sol. in alcohol. (Buchner, W. A. B. **52, 2.** 644.)

$+\frac{1}{2}H_2O$. Deliquescent. (Willm.)

Thallous hydrogen fluoride, TlF, HF.

Sol. in 1 pt. H_2O. (Buchner.)

Thallic fluoride, TlF_3.

Insol. in H_2O and cold HCl+Aq. (Willm.)

Thallous hydroxide, $TlOH$.

Sol. in H_2O and alcohol.

$+H_2O$. (Willm, Bull. Soc. (2) **5.** 354.)

Thallic hydroxide, $Tl_2O_3, H_2O=TlO(OH)$.

Insol. in H_2O. Sol. in dil. acids and ammonium salts +Aq. Insol. in caustic alkali solutions.

$Tl(OH)_3$. Easily sol. in dil. HCl or H_2SO_4+Aq. (Carnegie, C. N. **60.** 113.)

Thallous iodide, TlI.

Very sl. sol. in H_2O.

1 pt. TlI is sol. in pts. H_2O at t°. C=according to Crookes; H=according to Hebberling; L=according to Lamy; W=according to Werther.

13·5°	15°	16°	16-17°	19·4°	
20,000	4450	16,000	11,676	14,654	pts. H_2O,
W	C	L	H	W	

20°	23·4°	45°	100°	100°	
11,954	10,482	5407	842	804	pts. H_2O.
W	W	W	C	H	

Sol. in 17,000 pts. H_2O at 20°. (Long, Z. anal. **30.** 342.)

Insol. in dil. KI+Aq (1 % KI). (Baubigny.)

Much more insol. in KI+Aq than in H_2O; 1 pt. dissolves in 75,000 pts. dil. KI+Aq. (Lamy.)

Also less sol. in acetic acid than in H_2O. (Carstanjen.)

Not decomp. by dil. H_2SO_4, HCl, or alkalies +Aq. Decomp. by hot dil. HNO_3+Aq, and cold conc. HNO_3. Sol. in aqua regia.

Nearly insol. in $Na_2S_2O_3$+Aq, and absolutely insol. therein in presence of Pb salts. (Werner, C. N. **53.** 51.)

Insol. in NH_4OH+Aq. (Werther.) Not wholly insol. in NH_4OH+Aq, and solnbility is increased by presence of $(NH_4)_2SO_4$ or NH_4Cl. (Baubigny, C. R. **113.** 544.)

Sol. in 13,000 pts. NH_4OH+Aq ($6\frac{1}{2}$ or $2\frac{1}{2}$ % NH_3). Sol. in 17,000 pts. NH_4OH+Aq ($1\frac{1}{4}$ % NH_3). (Long.)

Sol. in 56,336 pts. 85 % alcohol at 13°. (Werther.) Sol. in 18,934 pts. 98 % alcohol at 19°. (Hebberling.)

When TlI is shaken with alcohol of 78° (1 vol. H_2O+3 vols. 98 % alcohol) at 22°, and let stand with TlI for 24 hours, and then evaporated to $\frac{1}{8}$ vol., there is shown no ppt. by NH_4SH+Aq. (Baubigny.)

Sol. in 260,000 pts. 90 % alcohol, and 37,000 pts. 50 % alcohol at 20°. (Long.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Thallic iodide, TlI_3.

Sol. in ether.

Thallothallic iodide, $Tl_3I_4=5TlI, TlI_3$.

Sol. in H_2O. (Jörgensen, J. pr. (2) **6.** 82.)

Thallous oxide, Tl_2O.

Deliquescent. Sol. in H_2O.

See **Thallous hydroxide.**

Thallic oxide, Tl_2O_3.

Insol. in H_2O. Not attacked by cold H_2SO_4. Sol. in hot H_2SO_4. Sol. in cold HCl+Aq.

Insol. in alkalies+Aq. (Werther, J. pr. **91.** 385.)

Thallium *di*oxide, TlO_2.
Insol. in H_2O. (Piccini, Gazz. ch. it. **17.** 450.)

Thallic oxide ammonia, Tl_2O_3, $6NH_3$.
Decomp. by much H_2O. Insol. in alcohol. (Carstanjen.)

Thallium phosphide (?).
Ppt. (Crookes.)

Thallous selenide, Tl_2Se.
Insol. in H_2O. Scarcely attacked by cold dil. H_2SO_4+Aq, but dissolves when heated. (Carstanjen.)

Thallothallic selenide.
Not attacked by cold conc. or boiling dil. H_2SO_4+Aq. Conc. H_2SO_4 decomposes. (Carstanjen.)

Thallous sulphide, Tl_2S.
Insol. in H_2O, $(NH_4)_2S$+Aq, NH_4OH+Aq, KCN+Aq, and in alkali carbonates, and hydrates +Aq. Difficultly sol. in a solution of oxalic acid or acetic acid. (Crookes.) Easily sol. in HNO_3, and H_2SO_4+Aq. Difficultly sol. in HCl+Aq. (Willm.)

Thallic sulphide, Tl_2S_3.
Insol. in H_2O. Insol. in cold, sol. in warm dil. H_2SO_4+Aq without separation of S. Sol. in other dilute acids with separation of S. (Carstanjen.)

Thallothallic sulphide, $5Tl_2S$, $3Tl_2S_3$.
Very slowly decomp. by cold dil. H_2SO_4+Aq.
Tl_2S, Tl_2S_3. (Carstanjen.)
Tl_2S, $2Tl_2S_3$. Decomp. by dil. acids. (Schneider, J. pr. (2) **10.** 55.)

Thallium telluride, Tl_2Te.
(Fabre, C. R. **105.** 673.)

Thio-
For acids and salts with prefix **thio-**, *see also under* **sulpho-**.

Thioantimonic acid.
See **Sulphantimonic acid.**

Thioarsenic acid.
See **Sulpharsenic acid.**

Thiomolybdic acid.
See **Sulphomolybdic acid.**

Thionamic acid, $NH_3SO_2 = NH_2SO(OH)$.
Very deliquescent, and sol. in H_2O.
H_2O solution decomp. gradually. (Rose, Pogg. **33.** 275; **42.** 425.)

Ammonium thionamate, $NH_2SO(ONH_4)$.
Deliquescent. Sol. in H_2O; easily decomp. when in solution. (Rose.)

***Di*thionic acid.**
See **Dithionic acid.**

***Tri*thionic acid.**
See **Trithionic acid.**

***Tetra*thionic acid.**
See **Tetrathionic acid.**

***Penta*thionic acid.**
See **Pentathionic acid.**

Thionyl amide, $SO_2(NH_2)_2$.
Very sol. in H_2O. (Regnault, A. ch. **69.** 170; Mente, A. **248.** 267.)
Insol. in alcohol, ether, etc. (Traube, B. **26.** 607.)

Silver thionyl amide, $SO_2(NHAg)_2$.
Sl. sol. in cold H_2O. Sol. in HNO_3, and $(NH_4)_2CO_3$+Aq. (Traube, B. **26.** 607.)

Thionyl chloride, SO_2Cl.
Decomp. by moist air, water, or abs. alcohol; more rapidly by alkalies, HCl, SO_2, etc. (Schiff, A. **102.** 111.)

Thionyl imide, SO_2NH.
Sol. in H_2O. (Traube, B. **26.** 607.)

Ammonium thionyl imide, $SO_2N(NH_4)$.
Sol. in H_2O; insol. in alcohol. (Traube.)

Barium ——, $(SO_2N)_2Ba + 2H_2O$.
Sol. in H_2O. (Traube.)

Potassium ——, SO_2NK.
Not very sol. in H_2O.

Sodium ——, SO_2NNa.
Very sol. in H_2O.

Thiophosphamic acid, $H_2PNH_2O_2S$ (?).
Known only in its salts. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Cadmium thiophosphamate, $CdPNH_2O_2S$.
Sol. in dil. acids, and NH_4OH+Aq. (G. and H.)

Lead ——, $PbPNH_2O_2S$.
Ppt. Sol. in dil. HNO_3+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Thiophospho*di*amic acid, $H_2PN_2H_4OS$.
Known only in solution, which soon decomposes. (G. and H.)

Cadmium thiophospho*di*amate, $Cd(PN_2H_4OS)_2$.
Insol. in H_2O; sol. in dil. acids, and NH_4OH+Aq. (G. and H.)

Cupric ——, $Cu(PN_2H_4OS)_2$.
Insol. in H_2O, dil. HCl, or NH_4OH+Aq. Sol. in KCN+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Lead ——, $Pb(PN_2H_4OS)_2$.
Insol. in H_2O. Sol. in dil. HNO_3+Aq.

Nickel ——, $Ni(PN_2H_4OS)_2$.
Sol. in dil. acids, and NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Zinc ——, $Zn(PN_2H_4OS)_2$.
Ppt. Sol. in dil. acids, and NH_4OH+Aq. (Gladstone and Holmes.)

Thiophosphoric acid, $H_3PSO_3 = PS(OH)_3$.

Known only in its salts.

Ammonium magnesium thiophosphate, $NH_4MgPSO_3 + 9H_2O$.

Sl. sol. in cold H_2O. (Kubierschky, J. pr. (2) **31.** 100.)

Barium ——, $Ba_3(PSO_3)_2$.

Insol. in H_2O. (Wurtz, A. ch. (3) **20.** 473.)

Cobalt ——.

Insol. in H_2O, but partially decomp. when boiled therewith. (Wurtz.)

Cupric ——.

Insol. in H_2O; very easily decomp. (Wurtz.)

Ferric ——.

Insol. in H_2O. (Wurtz.)

Magnesium ——, $Mg_3(PSO_3)_2 + 20H_2O$.

Sl. sol. in cold H_2O. (Kubierschky, J. pr. (2) **31.** 99.)

Nickel ——.

Insol. in H_2O, but decomp. when boiled therewith. (Wurtz.)

Potassium ——, K_3PSO_3.

Very sol. in H_2O. Known only in aqueous solution. (Wurtz.)

Sodium ——, $Na_3PSO_3 + 12H_2O$.

Easily sol. in boiling H_2O. Cryst. out on cooling. (Wurtz, A. ch. (3) **20.** 472.)
Insol. in alcohol.

Strontium ——.

Insol. in H_2O. (Wurtz.)

***Di*thiophosphoric acid,** $H_3PS_2O_2$.

Known only in its salts.

Ammonium *di*thiophosphate, $(NH_4)_3PS_2O_2 + 2H_2O$.

Sl. efflorescent. Sol. in H_2O. (Kubierschky, J. pr. (2) **31.** 93.)

Ammonium magnesium ——, $NH_4MgPS_2O_2 + 6H_2O$.

Sl. sol. in cold H_2O. (Kubierschky.)

Barium ——, $Ba_3(PS_2O_2)_2 + 8H_2O$.

Precipitate. (Kubierschky, J. pr. (2) **31.** 103.)

Calcium ——.

Very easily decomposed. (Kubierschky.)

Sodium ——, $Na_3PS_2O_2 + 11H_2O$.

Very sol. in H_2O. (Kubierschky, J. pr. (2) **31.** 93.)

Thiophosphorous acid.

Ammonium thiophosphite (?), $(NH_4)_4P_2S_2O_3 + 3H_2O$.

Sol. in H_2O. (Lemoine, C. R. **98.** 45.)
$+ 6H_2O$.

Sodium thiophosphite (?), $Na_4P_2S_2O_3 + 5H_2O = P_2O_3, 2Na_2S + 5H_2O$.

Sol. in H_2O. (Lemoine, C. R. **98.** 45.)

$Na_6P_2S_2O_4 + 4H_2O = P_2O_3, 3Na_2O, 2H_2S + 2H_2O$. Sol. in H_2O. (Lemoine, *l.c.*)

Thiophosphoryl *tri*amide, $PS(NH_2)_3$.

Rapidly decomp. by H_2O. Scarcely sol. in alcohol, ether, or CS_2. (Chevrier, C. R. **66.** 748.)

***Meta*thiophosphoryl bromide,** PS_2Br.

Decomp. by H_2O. Insol. in ether. (Michaelis, A. **164.** 9.)

***Ortho*thiophosphoryl bromide,** $PSBr_3$.

Slowly decomp. by cold, rapidly by hot H_2O, but volatile with only partial decomp. with steam. Easily sol. in ether, CS_2, PCl_3, PBr_3. Decomp. by cold alcohol. Forms hydrate $PSBr_3 + H_2O$. (Michaelis, A. **164.** 9.)

***Pyro*thiophosphoryl bromide,** $P_2S_3Br_4$.

Decomp. by H_2O and alcohol. Sol. in CS_2 and ether. (Michaelis.)

Thiophosphoryl phosphorus bromide, $PSBr_3, PBr_3$.

Decomp. by H_2O into $PSBr_3$. (Michaelis.)

Thiophosphoryl chloride, $PSCl_3$.

Very slowly decomp. by H_2O, and may be distilled with steam without much decomp. Decomp. by alcohol. Miscible with CS_2. (Baudrimont, J. pr. **87.** 301.)

Thiophosphoryl *penta*chloride, PS_2Cl_5 (?).

Decomp. by H_2O. Sol. in alkalies with residue of S. Attacked violently by HNO_3, alcohol, ether, oil of turpentine. Miscible with CS_2. (Gladstone, Chem. Soc. **3.** 5.)

Thiophosphoryl fluoride, PSF_3.

Slowly sol. in H_2O with decomp. Sl. sol. in ether.
Insol. in H_2SO_4, CS_2, or benzene. (Thorpe and Rodger, Chem. Soc. **55.** 306.)
More sol. in KOH or NaOH + Aq than in H_2O.

Thiosulphuric (*formerly* **Hyposulphurous) acid,** $H_2S_2O_3$.

Known only in aqueous solution, which is extremely unstable, and decomposes very quickly after its formation. The time before decomposition is exactly proportional to the ratio of the weight of H_2O to the weight of $H_2S_2O_3$ present; *i.e.*, if one solution contains twice as much H_2O for a given amt. of $H_2S_2O_3$ as a second solution, the first solution will decompose in twice the length of time. The length of time is about 20 secs. at 10°, and 2 secs. at 50° for conc. solutions, to 120 secs. at 10° and 12 secs. at 50° for very dilute solutions. See Landolt (B. **16.** 2958) for further figures; also Winkelmann (B. **18.** 406).

Thiosulphates.

The thiosulphates of the alkalies and of Ca and Sr are easily sol. in H_2O; Ba and Sr salts are sl. sol. and the other salts insol. The salts of the metals dissolve in alkali thiosulphates + Aq. All are insol. in alcohol.

Ammonium thiosulphate, $(NH_4)_2S_2O_3$.

Very deliquescent. Very sol. in H_2O.

Crystallises with $\frac{1}{3}H_2O$. (Rammelsberg, Pogg. **56.** 298.) Anhydrous. (Arppe, A. **96.** 113.)

Insol. in alcohol. (Arppe.)

Ammonium cadmium thiosulphate, $3(NH_4)_2S_2O_3$, $CdS_2O_3+3H_2O$.

Can be recryst. from warm H_2O. (Fock and Klüss, B. **23.** 1758.)

$+H_2O$. (F. and K.)

$(NH_4)_2S_2O_3$, CdS_2O_3. (F. and K.)

Ammonium lead thiosulphate, $2(NH_4)_2S_2O_3$, $PbS_2O_3+3H_2O$.

Easily and completely sol. in cold H_2O, but deposits PbS_2O_3 by standing or warming. (Rammelsberg, Pogg. **56.** 312.)

Ammonium magnesium thiosulphate, $(NH_4)_2Mg(S_2O_3)_2+6H_2O$.

Very deliquescent, and sol. in H_2O. (Kessler, Pogg. **74.** 283.)

Not deliquescent. (Fock and Klüss, B. **23.** 540.)

Ammonium mercuric thiosulphate, $4(NH_4)_2S_2O_3$, $HgS_2O_3+2H_2O$.

Sol. in H_2O, from which it is precipitated by alcohol. Extremely easily decomp. (Rammelsberg, Pogg. **56.** 318.)

Ammonium potassium thiosulphate, $NH_4KS_2O_3$.

Sol. in H_2O. (Fock and Klüss, B. **23,** 536.)

Ammonium silver thiosulphate, $2(NH_4)_2S_2O_3$, $Ag_2S_2O_3+xH_2O$.

Easily sol. in H_2O. Somewhat sol. in alcohol. (Herschel, Edinb. Phil. J. **1.** 398.)

$(NH_4)_2S_2O_3$, $Ag_2S_2O_3+xH_2O$. Nearly insol. in H_2O; sol. in NH_4OH+Aq, from which it is repptd. by an acid. (Herschel.)

Barium thiosulphate, $BaS_2O_3+H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **21.** 437.)

Insol. in alcohol.

1 pt. cannot be dissolved in 2000 pts. H_2O. Sol. in dil. $HCl+Aq$ without decomposition. (Herschel, **1819.**)

Pptd. from BaS_2O_3+Aq by dil. alcohol. (Sobrero and Selmi, A. ch. (3) **28.** 211.)

Barium cadmium thiosulphate, $2BaS_2O_3$, $CdS_2O_3+8H_2O$.

Sl. sol. in H_2O. (Fock and Klüss, B. **23.** 1761.)

$3BaS_2O_3$, $CdS_2O_3+8H_2O$. Sl. sol. in H_2O.

Barium cuprous thiosulphate.

Easily sol. in hot, difficultly sol. in cold H_2O. (Cohen, Chem. Soc. **51.** 38.)

$2BaS_2O_3$, $Cu_2S_2O_3+7H_2O$. Nearly insol. in H_2O. (Vortmann, M. **9.** 165.)

Barium gold thiosulphate.

Sl. sol. in H_2O. Insol. in alcohol. (Fordos and Gélis.)

Barium lead thiosulphate.

Difficultly sol. in H_2O. (Rammelsberg, Pogg. **56.** 313.)

Barium thiosulphate chloride, BaS_2O_3, $BaCl_2+2H_2O$.

Sol. in H_2O. (Fock and Klüss, B. **23.** 3001.)

Bismuth potassium thiosulphate, $K_3Bi(S_2O_3)_2+H_2O$.

Sol. in H_2O. Insol. in alcohol. (Carnot, C. R. **83.** 390.)

Bismuth sodium thiosulphate.

Very sol. in H_2O, and also in alcohol. (Carnot, C. R. **83.** 338.)

Cadmium thiosulphate, $CdS_2O_3+2H_2O$.

Sol. in H_2O. Insol. in alcohol. (Vortmann and Padberg, B. **22.** 2638.)

Cadmium potassium thiosulphate, $3CdS_2O_3$, $5K_2S_2O_3$.

Cannot be recryst. without decomp. (Fock and Klüss, B. **23.** 1753.)

CdS_2O_3, $3K_2S_2O_3+2H_2O$. Can be crystallised from H_2O without decomp. (F. and K.)

Cadmium sodium thiosulphate, CdS_2O_3, $3Na_2S_2O_3+16H_2O$.

Not deliquescent. Sol. in H_2O. (Jochum, C. C. **1885.** 642.)

$+9H_2O$. (Vortmann and Padberg, B. **22.** 2639.)

$+3H_2O$. Deliquescent. (Fock and Klüss, B. **23.** 1157.)

$2CdS_2O_3$, $Na_2S_2O_3+7H_2O$. (V. and P.)

$3CdS_2O_3$, $Na_2S_2O_3+9H_2O$. (V. and P.)

Cadmium strontium thiosulphate, CdS_2O_3, $3SrS_2O_3+10H_2O$.

(Fock and Klüss, B. **23.** 1763.)

Calcium thiosulphate, $CaS_2O_3+6H_2O$.

Sol. in 1 pt. H_2O at 3°.

Aqueous solution saturated at 10° has sp. gr. 1·300. Solution with sp. gr. 1·11437 at 15·5° contains 0·2081 of its weight in $CaS_2O_3+6H_2O$. Decomp. on heating. Insol. in alcohol (sp. gr. 0·8234). (Herschel, A. ch. **14.** 355.)

Calcium lead thiosulphate, $2CaS_2O_3$, $PbS_2O_3+4H_2O$.

Decomp. by H_2O. (Rammelsberg.)

Calcium potassium thiosulphate, CaS_2O_3, $3K_2S_2O_3+5H_2O$.

Sol. in H_2O. (Fock and Klüss, B. **24.** 3016.)

Calcium silver thiosulphate, $2CaS_2O_3$, $Ag_2S_2O_3+xH_2O$.

Easily sol. in H_2O; less sol. in alcohol.

CaS_2O_3, $Ag_2S_2O_3+xH_2O$. Sl. sol. in H_2O, abundantly in NH_4OH+Aq. (Herschel, **1819.**)

Cobaltous thiosulphate, $CoS_2O_3+6H_2O$.

Sol. in H_2O. (Rammelsberg.)

Cobaltous sodium thiosulphate, $2CoS_2O_3$, $5Na_2S_2O_3+25H_2O$.

Efflorescent. Sol. in H_2O. (Jochum.)

Could not be obtained by Vortmann and Padberg.

CoS_2O_3, $3Na_2S_2O_3+15H_2O$. Sol. in H_2O. (Vortmann and Padberg, B. **22.** 2641.)

Cuprous thiosulphate,
$Cu_2H_4(S_2O_3)_2$.

Sl. sol. in H_2O. Abun
+Aq, NH_4Cl+Aq, NH
+Aq. Sol. in HCl or
W. A. B. **13.** 443.)

Cuprous mercurous
$3Hg_2S_2O_3$.

Insol. or sl. sol. in
H_2O. HNO_3+Aq
melsberg, Pogg. **56**.

Cuprous potassium
$K_2S_2O_3+2H_2O$.

Sl. sol. in H_2O;
pptn. of CuS.
(Rammelsberg, Pogg.
$Cu_2S_2O_3$, $2K_2S_2O_3$
insol. in $K_2S_2O_3$+Aq.
39.)
+$3H_2O$. Scarcely
decomp. in hot H_2O,
evolution of SO_2.
$Cu_2S_2O_3$, $3K_2S_2O_3$
than $Cu_2S_2O_3$, $K_2S_2O_3$
decomp. by boiling
Aq. (Rammelsberg.)

Cuprous sodium
$7Na_2S_2O_3+2H_2O$.

Pptd. from aqueous
(Jochum, C. C. 1885.
+$12H_2O$. Sol. in
(Jochum.)
$Cu_2S_2O_3$, $3Na_2S_2O_3$+
insol. in alcohol. (Rammel
+$6H_2O$. (Jochum.)
$3Cu_2S_2O_3$, $2Na_2S_2O_3$+
H_2O. (Vortmann.)
+$5H_2O$. (Lenz. A. **40.**
cording to Jochum is—
$5Cu_2S_2O_3$, $4Na_2S_2O_3+8H_2O$.
or alcohol. Sol. in HCl+Aq
of SO_2, also in dil. H_2SO_4 or
in NH_4OH+Aq. (Jochum.)
+$6H_2O$. As above. (Jochum
$Cu_2S_2O_3$, $Na_2S_2O_3+H_2O$.
sol. in $Na_2S_2O_3$+Aq. (Russel,
233.)
+$3H_2O$. Very sol. in H_2O.
M. **9.** 165.)
$5Cu_2S_2O_3$, $3Na_2S_2O_3$, $2Na_2SO_4+H_2O$
in H_2O. (Jochum.)

Cuprocupric sodium thiosulphate
$Cu_2S_2O_3$, CuS_2O_3, $2Na_2S_2O_3$, $4NH_3$

Insol. in, but decomp. by hot H_2O.
$HC_2H_3O_2$+Aq. Sol. in NH_4OH+Aq
$Na_2S_2O_3$+Aq. (Schütte, C. R. **42.** 1267.)

Cuprous sodium thiosulphate cupric sulph
$Cu_2S_2O_3$, $Na_2S_2O_3$, $CuS+4H_2O$.

Sl. sol. in H_2O; easily sol. in $Na_2S_2O_3$+Aq
and NH_4OH+Aq; insol. in alcohol. (Lenz,
A. **40.** 99.)
$Cu_2S_2O_3$, $Na_2S_2O_3$, 2CuS. Sol. in H_2O or
dil. HCl+Aq. (Kessel, B. **11.** 1585.)

ThH$_2$.

. HCl+Aq. (Winkler, B.

le, Th(OH)$_4$.

except oxalic, molybdic, and s.

li hydroxides, but easily sol. onates+Aq. More sol. in $_2CO_3$+Aq than in $(NH_4)_2CO_3$+ zelius.) Not pptd. in presence itric acids. (Chydenius, Pogg.

Insol. in water and acids at

le.

.

le, ThO_2.

ted is insol. in HCl, and HNO_3+ H_2SO_4 by heating to boiling and addition of H_2O. Insol. in alkali carbonates+Aq.

m oxide.

$_2$O after having been treated with $_3$ or HCl+Aq, even if previously

*per***oxide**, Th_2O_7.

tate. (Cleve, C. R. **100**. 605.)

oxychloride.

p. by H_2O into $ThCl_4$ and ThO_2.

oxysulphide, ThS_2, $2ThO_2$.

lenius.)

m phosphide.

l. in H_2O. (Berzelius.)

m sulphide, ThS_2.

l. in warm H_2SO_4. Very slightly at- d by HNO_3 or HCl+Aq. Sol. in hot regia. (Berzelius.)

lium, Tm (?).

leve, C. R. **89**. 251.)

nsists of at least two elements, according lson and Krüss.

lium oxide, Tm_2O_3 (?).

leve, C. R. **89**. 478.)

Sn.

ol. in H_2O. Slowly sol. in dil. cold -Aq, but rapidly sol. if hot and conc. ly sol. in hot dil. [illegible]+Aq, but decomp. ot conc. H_2S[illegible] ly sol. in cold aqua Attacked [illegible] conc. HNO_3+ pptn. [illegible] slowly sol. in O_2 [illegible] pt. H_2O) [illegible]

Sn remains permanently in solution; HCl+Aq has a similar action. (Ordway, Am. J. Sci. (2) **23**. 220.) Easily sol. in the cold in mixture of 1 vol. H_2SO_4, 2 vols. HNO_3, and 3 vols. H_2O. (Basset, C. N. **53**. 172.)

HNO_3+Aq containing less than 12 % HNO_3 attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution. HNO_3+Aq (12-45 % HNO_3) completely dissolves Sn, but solution becomes turbid on standing. HNO_3+Aq containing more than 45 % HNO_3 does not dissolve Sn, but forms a white substance, which is sol. in H_2O if over 70 % acid is used; this solution soon becomes turbid. (Montemartini, Gazz. ch. it. **22**. 384.)

Much more sol. in acids when small quantities of metallic salts have been added. This is most noticeable when $PtCl_4$ or tartar emetic is added to HCl+Aq. HCl+Aq with tartar emetic exerts 11 times, and with $PtCl_4$ 13 times the action exhibited by pure acid. (Millon, C. R. **21**. 47.)

Sol. in boiling alum+Aq (1 pt. alum to 4 pts. H_2O).

Sol. in $KHSO_3$, NH_4Cl (1:4), and $K_2C_4H_4O_6$+Aq. Sl. sol. in $KC_2H_3O_2$+Aq, but not attacked by $MgSO_4$, K_2SO_4, KNO_3, or Na_2SO_4+Aq. (Cludius, J. pr. **9**. 161.)

Sol. in alkalies+Aq.

Attacked easily by conc. NaCl, KCl, or NH_4NO_3+Aq; not attacked by NH_4Cl+Aq. (Hallock, Am. Ch. J. **6**. 52.)

Sol. in $Fe(NO_3)_3$+Aq in presence of HNO_3+Aq in proportion of 1 atom Sn to 1 atom Fe. (Lepèz and Storch, W. A. B. **98**, **2b**. 268.)

Not attacked by sugar+Aq. (Klein, C. R. **102**. 1170.)

Tin is not attacked by distilled H_2O when air is passed through it for a week.

Solubility in dil. saline solutions.

100 ccm. H_2O containing 0·5 g. NaCl or KCl dissolve 6 mg. Sn from 11·8 sq. cm. in one week when air without CO_2 is passed through the solution, but none at all when the air contains CO_2.

100 ccm. H_2O containing 1 g. NH_4Cl dissolve 5 mg. Sn under above conditions without CO_2, and none with CO_2.

With 1 g. $MgCl_2$, 1 mg. Sn was dissolved without CO_2, and none with CO_2.

With 1 g. K_2SO_4, 2 mg. Sn were dissolved without CO_2, and none with CO_2.

With 1 g. KNO_3, 3 mg. Sn were dissolved without CO_2, and 1 mg. with CO_2.

With 1 g. Na_2CO_3, 7 mg. Sn were dissolved without CO_2.

With 1 g. NaOH, 220 mg. Sn were dissolved without CO_2.

CaO_2H_2+Aq did not dissolve. (Wagner, Dingl. **221**. 260.)

Stannous bromide, $SnBr_2$.

Sol. in H_2O.

nnic bromide, $SnBr_4$.

liquescent. Sol. in H_2O without evolu- heat. (Balard.)

H_2O. (Preis and Raymann, C. C. **1882**.

Sp. gr. of $Na_2S_2O_3$ + Aq at 19°.
% = % $Na_2S_2O_3 + 5H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1·0052	18	1·0975	35	1·1986
2	1·0105	19	1·1031	36	1·2048
3	1·0158	20	1·1087	37	1·2110
4	1·0211	21	1·1145	38	1·2172
5	1·0264	22	1·1204	39	1·2234
6	1·0317	23	1·1263	40	1·2297
7	1·0370	24	1·1322	41	1·2362
8	1·0423	25	1·1381	42	1·2427
9	1·0476	26	1·1440	43	1·2492
10	1·0529	27	1·1499	44	1·2558
11	1·0584	28	1·1558	45	1·2624
12	1·0639	29	1·1617	46	1·2690
13	1·0695	30	1·1676	47	1·2756
14	1·0751	31	1·1738	48	1·2822
15	1·0807	32	1·1800	49	1·2888
16	1·0863	33	1·1862	50	1·2954
17	1·0919	34	1·1924	...	...

(Schiff, A. **113**. 188.)

B.-pt. of $Na_2S_2O_3$ + Aq. P = pts. $Na_2S_2O_3$ to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	14	110°	104	119°	201
102	27	111	113	120	214·5
103	39	112	122	121	229
104	49·5	113	131·5	122	244
105	59	114	141·5	123	262
106	68	115	152	124	283
107	77	116	164	125	311
108	86	117	175·75	126	348
109	95	118	188	...	...

(Gerlach, Z. anal. **26**. 436.)

Insol. in alcohol.

Sol. in oil of turpentine (Edison, Am. Chemist, **7**. 127). Insol. therein (Techn. J. B. **27**. 1003).

Insol. in ethyl acetate. (Casaseca, C. R. **30**. 821.)

$+3H_2O$. Easily decomp. in moist air. (Jochum, C. C. **1885**. 642.)

Sodium thallous thiosulphate, $3Na_2S_2O_3, 2Tl_2S_2O_3 + 10H_2O$.

Sol. in H_2O. (Werther.)

$+8H_2O$. (Jochum.)

$2Na_2S_2O_3, Tl_2S_2O_3 + 8H_2O$. (Vortmann and Padberg, B. **22**. 2638.)

Sodium zinc thiosulphate, $Na_2S_2O_3, 2ZnS_2O_3 + 23H_2O$.

Sol. in H_2O. (Jochum, C. C. **1885**. 642.)

$3Na_2S_2O_3, 2ZnS_2O_3 + 10H_2O$. Deliquescent. (Vortmann and Padberg, B. **22**. 2640.)

Strontium thiosulphate, $SrS_2O_3 + 5H_2O$.

Permanent. Sol. in 6 pts. cold H_2O (Gay-Lussac); in 4 pts. H_2O at 13°, and 1·75 pts. boiling H_2O (Herschel, **1819**).

Gradually efflorescent. Insol. in alcohol. (Herschel.)

100 pts. H_2O at 10° dissolve 16·6 pts. (Ure's Dict.)

$+H_2O$. (Kessler.)

Thallous thiosulphate.

Ppt. Sl. sol. in cold, easily sol. in hot H_2O. (Crookes.)

Easily sol. in $Na_2S_2O_3$ + Aq. (Jochum.)

Tin thiosulphate (?).

Sol. in H_2O.

Zinc thiosulphate, $ZnS_2O_3 + xH_2O$.

Very deliquescent, and very sol. in H_2O and alcohol. (Rammelsberg.)

Zinc thiosulphate ammonia, $ZnS_2O_3, 2NH_3$.

Decomp. by H_2O. Sol. in NH_4OH + Aq, from which it is pptd. by alcohol. (Rammelsberg, Pogg. **56**. 62.)

Thio*di*thiazyl *di*chloride, $S_3N_2Cl_2$.

See **Nitrogen sulphochloride.**

Thio*tri*thiazyl chloride, S_4N_3Cl.

See **Nitrogen sulphochloride.**

Thio*tri*thiazyl nitrate, $S_4N_3NO_3$.

Sol. in H_2O with decomp. Sol. in HNO_3 + Aq. (Demarçay, C. R. **91**. 1066.)

Thio*tri*thiazyl sulphate $(S_4N_3)HSO_4$.

Stable on air. Sol. in H_2O with decomp. (Demarçay, C. R. **91**. 854, 1066.)

***Di*thio*tetra*thiazyl *di*chloride,** $S_6N_4Cl_2$.

See **Nitrogen sulphochloride.**

Thorium, Th.

Not oxidised by boiling H_2O.

Quickly sol. (Chydenius, Pogg. **119**. 43), very slowly sol. by long boiling (Berzelius, Pogg. **16**. 385) in HNO_3 + Aq. Insol. in cold, easily sol. in warm dil. H_2SO_4 + Aq. Slowly sol. in cold, rapidly in hot HCl + Aq. Easily oxidised by aqua regia. Insol. in KOH + Aq or HF + Aq.

Sl. sol. in dil. H_2SO_4 + Aq; decomp. by conc. H_2SO_4. Very sl. sol. in dil., and less in conc. HNO_3 + Aq. Easily sol. in conc. HCl + Aq, and aqua regia. (Nilson, B. **15**. 2521.)

Thorium *di*bromide, $ThBr_2$.

Sol. in H_2O with partial decomp. (Troost and Ouvrard, A. ch. (6) **17**. 227.)

Thorium *tetra*bromide, $ThBr_4$.

Sol. in H_2O. (Berzelius.)

Very hygroscopic, and sol. in H_2O with partial decomp. (Troost and Ouvrard, A. ch. (6) **17**. 229.)

Thorium chloride, $ThCl_4$.

Anhydrous. Extremely deliquescent, and sol. in H_2O with evolution of heat. Sol. in alcohol.

$+8H_2O$. Very deliquescent. Very sol. in H_2O. Less sol. in conc. HCl + Aq. Completely sol. in alcohol.

Thorium fluoride, $ThF_4 + 4H_2O$.

Insol. in H_2O or HF + Aq.

Thorium hydride, ThH_2.

Decomp. by dil. HCl+Aq. (Winkler, B. **24**. 873.)

Thorium hydroxide, $Th(OH)_4$.

Insol. in H_2O.

Sol. in acids, except oxalic, molybdic, and hydrofluoric acids.

Insol. in alkali hydroxides, but easily sol. in alkali carbonates+Aq. More sol. in $NH_4OH+(NH_4)_2CO_3$+Aq than in $(NH_4)_2CO_3$+Aq alone. (Berzelius.) Not pptd. in presence of tartaric and citric acids. (Chydenius, Pogg. **119**. 43.)

$4ThO_2$, H_2O. Insol. in water and acids at boiling temp.

Thorium iodide.

Sol. in H_2O.

Thorium oxide, ThO_2.

When ignited is insol. in HCl, and HNO_3+Aq. Sol. in H_2SO_4 by heating to boiling and subsequent addition of H_2O. Insol. in alkali hydrates or carbonates+Aq.

***Meta*thorium oxide.**

Sol. in H_2O after having been treated with conc. HNO_3 or HCl+Aq, even if previously ignited.

Thorium *per*oxide, Th_2O_7.

Precipitate. (Cleve, C. R. **100**. 605.)

Thorium oxychloride.

Decomp. by H_2O into $ThCl_4$ and ThO_2.

Thorium oxysulphide, ThS_2, $2ThO_2$.

(Chydenius.)

Thorium phosphide.

Insol. in H_2O. (Berzelius.)

Thorium sulphide, ThS_2.

Insol. in warm H_2SO_4. Very slightly attacked by HNO_3 or HCl+Aq. Sol. in hot aqua regia. (Berzelius.)

Thulium, Tm (?).

(Cleve, C. R. **89**. 251.)

Consists of at least two elements, according to Nilson and Krüss.

Thulium oxide, Tm_2O_3 (?).

(Cleve, C. R. **89**. 478.)

Tin, Sn.

Insol. in H_2O. Slowly sol. in dil. cold HCl+Aq, but rapidly sol. if hot and conc. Slowly sol. in hot dil. H_2SO_4+Aq, but decomp. by hot conc. H_2SO_4. Readily sol. in cold aqua regia. Attacked violently by conc. HNO_3+Aq with pptn. of SnO_2. Completely sol. in dil. cold HNO_3+Aq (1 pt. HNO_3 : 1 pt. H_2O) at 22°. (Hay, C. N. **22**. 298.) Not attacked by pure conc. HNO_3+Aq of 1·512-1·419 sp. gr., but violently attacked by less conc. acid. Also attacked by most conc. acid if it contains NO_2. (Millon, A. ch. (3) **6**. 95.)

If Sn is placed in dil. HNO_3+Aq of 1·15 sp. gr. it is sl. dissolved, but soon pptd. again as SnO_2. If a small amt. of NH_4Cl is added, the Sn remains permanently in solution; HCl+Aq has a similar action. (Ordway, Am. J. Sci. (2) **23**. 220.) Easily sol. in the cold in mixture of 1 vol. H_2SO_4, 2 vols. HNO_3, and 3 vols. H_2O. (Basset, C. N. **53**. 172.)

HNO_3+Aq containing less than 12 % HNO_3 attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution. HNO_3+Aq (12-45 % HNO_3) completely dissolves Sn, but solution becomes turbid on standing. HNO_3+Aq containing more than 45 % HNO_3 does not dissolve Sn, but forms a white substance, which is sol. in H_2O if over 70 % acid is used; this solution soon becomes turbid. (Montemartini, Gazz. ch. it. **22**. 384.)

Much more sol. in acids when small quantities of metallic salts have been added. This is most noticeable when $PtCl_4$ or tartar emetic is added to HCl+Aq. HCl+Aq with tartar emetic exerts 11 times, and with $PtCl_4$ 13 times the action exhibited by pure acid. (Millon, C. R. **21**. 47.)

Sol. in boiling alum+Aq (1 pt. alum to 4 pts. H_2O).

Sol. in $KHSO_3$, NH_4Cl (1 : 4), and $K_2C_4H_4O_6$+Aq. Sl. sol. in $KC_2H_3O_2$+Aq, but not attacked by $MgSO_4$, K_2SO_4, KNO_3, or Na_2SO_4+Aq. (Cludius, J. pr. **9**. 161.)

Sol. in alkalies+Aq.

Attacked easily by conc. NaCl, KCl, or NH_4NO_3+Aq; not attacked by NH_4Cl+Aq. (Hallock, Am. Ch. J. **6**. 52.)

Sol. in $Fe(NO_3)_3$+Aq in presence of HNO_3+Aq in proportion of 1 atom Sn to 1 atom Fe. (Lepèz and Storch, W. A. B. **98**, **2b**. 268.)

Not attacked by sugar+Aq. (Klein, C. R. **102**. 1170.)

Tin is not attacked by distilled H_2O when air is passed through it for a week.

Solubility in dil. saline solutions.

100 ccm. H_2O containing 0·5 g. NaCl or KCl dissolve 6 mg. Sn from 11·8 sq. cm. in one week when air without CO_2 is passed through the solution, but none at all when the air contains CO_2.

100 ccm. H_2O containing 1 g. NH_4Cl dissolve 5 mg. Sn under above conditions without CO_2, and none with CO_2.

With 1 g. $MgCl_2$, 1 mg. Sn was dissolved without CO_2, and none with CO_2.

With 1 g. K_2SO_4, 2 mg. Sn were dissolved without CO_2, and none with CO_2.

With 1 g. KNO_3, 3 mg. Sn were dissolved without CO_2, and 1 mg. with CO_2.

With 1 g. Na_2CO_3, 7 mg. Sn were dissolved without CO_2.

With 1 g. NaOH, 220 mg. Sn were dissolved without CO_2.

CaO_2H_2+Aq did not dissolve. (Wagner, Dingl. **221**. 260.)

Stannous bromide, $SnBr_2$.

Sol. in H_2O.

Stannic bromide, $SnBr_4$.

Deliquescent. Sol. in H_2O without evolution of heat. (Balard.)

$+4H_2O$. (Preis and Raymann, C. C. **1882**. 773.)

Stannic hydrogen bromide, $SnBr_4$, 2HBr.
See **Bromostannic acid.**

Stannic bromide *with* **MBr.**
See **Bromostannate, M.**

Stannous chloride, $SnCl_2$, and $+2H_2O$.

Not deliquescent. 100 pts. H_2O dissolve 83·9 pts. $SnCl_2$ at 0°. (Engel, A. ch. (6) **17.** 347.) 100 pts. H_2O dissolve 269·8 pts. $SnCl_2$ at 15°, and sat. solution has sp. gr. 1·827. (Michel and Krafft, A. ch. (3) **41.** 478.) Sol. in a certain amount of H_2O without decomp., but more H_2O causes pptn. of SnO, $SnCl_2$.

$SnCl_2$+Aq absorbs O from air.

Melts in crystal H_2O at 46°. (Ordway.)

Sat. solution boils at 121·7°.

Sp. gr. of $SnCl_2$+Aq at 15° containing:

5 10 15 20 % $SnCl_2+2H_2O$,
1·0331 1·0684 1·1050 1·1442
25 30 35 40 % $SnCl_2+2H_2O$,
1·1855 1·2300 1·2779 1·3298
45 50 55 60 % $SnCl_2+2H_2O$,
1·3850 1·4451 1·5106 1·5823
65 70 75 % $SnCl_2+2H_2O$.
1·6598 1·7452 1·8399

(Gerlach, Dingl. **186.** 131.)

Solubility of $SnCl_2$ in HCl+Aq. $\frac{SnCl_2}{2}$ = ½ molecules $SnCl_2$ in milligrammes in 10 ccm. solution; HCl = molecules HCl in milligrammes in ditto; H_2O = amt. H_2O present in grammes.

$\frac{SnCl_2}{2}$	HCl	Sum of equiv.	Sp. gr. of solution	H_2O
74	0	74	1·532	8·33
66·7	6·6	73·3	1·489	8·35
63·75	13·54	77·29	1·472	8·198
68·4	24·8	93·2	1·524	7·869
81·2	34·9	116·1	1·625	7·305
94·2	40·0	134·2	1·724	6·880
117·6	44	161·6	1·883	6·108
147·6	49·4	197·0	2·114	5·387
156·4	66	222·4	2·190	4·715
157	78	235	2·199	4·309

(Engel, A. ch. (6) **17.** 347.)

Solubility is thus diminished by HCl+Aq, while there are less than 8-10 mols. HCl for 1 mol. $SnCl_2$. When that limit is passed the solubility rapidly increases. (Engel.)

Sol. in very dil. HCl or tartaric acid +Aq. Sol. in KOH+Aq. Sol. in conc. $SnOCl_2$+Aq. (Gerlach.) Sol. in NH_4Cl+Aq.

Sol. in absolute alcohol. Insol. in oil of turpentine.

$+4H_2O$. Deliquescent.

Does not exist. (Gerlach.)

Stannic chloride, $SnCl_4$.

(α) *Ordinary modification.*—Deliquescent. Sol. in H_2O. On diluting $SnCl_4$+Aq and boiling, SnO_2 separates out. $SnCl_4$+Aq is not pptd. by HNO_3, HCl, or H_2SO_4+Aq; H_3PO_4+Aq ppts. in a few days, and H_3AsO_4+Aq in a short time. No ppt. is formed by K_2SO_4, Na_2SO_4, KCl, NaCl, NH_4Cl, KNO_3, etc. +Aq. (Rose.)

Very sol. in absolute alcohol, from which it is pptd. by H_2O. Easily sol. in ether; decomp. by oil of turpentine. Miscible with CS_2 and Br_2.

Sp. gr. of $SnCl_4$+Aq at 15°.

% $SnCl_4$ $+5H_2O$	Sp. gr.	% $SnCl_4$ $+5H_2O$	Sp. gr.	% $SnCl_4$ $+5H_2O$	Sp. gr.
2	1·012	34	1·226	66	1·538
4	1·024	36	1·242	68	1·563
6	1·036	38	1·259	70	1·587
8	1·048	40	1·276	72	1·614
10	1·059	42	1·293	74	1·641
12	1·072	44	1·310	76	1·669
14	1·084	46	1·329	78	1·698
16	1·097	48	1·347	80	1·727
18	1·110	50	1·366	82	1·759
20	1·124	52	1·386	84	1·791
22	1·137	54	1·406	86	1·824
24	1·151	56	1·426	88	1·859
26	1·165	58	1·447	90	1·894
28	1·180	60	1·468	92	1·932
30	1·195	62	1·491	94	1·969
32	1·210	64	1·514	95	1·988

(Gerlach, Dingl. **178.** 49.)

$+2H_2O$. Sol. in H_2O.

$+3H_2O$.

$+5H_2O$. Very deliquescent, and sol. in H_2O. Decomp. by alcohol. Sol. in HCl+Aq.

$+8H_2O$. More deliquescent than the $5H_2O$ salt.

$+9H_2O$.

(β) *Metastannic chloride.*—Sol. in cold H_2O; solution coagulates on boiling. Conc. HCl+Aq ppts. from $SnCl_4$ + Aq. When solution does not contain HCl, the addition of HCl+Aq causes a ppt., which dissolves in H_2O. HNO_3, and H_2SO_4+Aq also ppt. K_2SO_4, Na_2SO_4, and NaCl+Aq produce ppts., insol. in H_2O, but sol. in HCl+Aq. NH_4Cl or KCl+Aq do not ppt. KNO_3+Aq ppts. slowly. (Rose.)

Stannous hydrogen chloride, $SnCl_2$, HCl+$3H_2O$.

Decomp. by H_2O.

Melts at −25°. (Engel, C. R. **106.** 1398.)

Stannic hydrogen chloride.
See **Chlorostannic acid.**

Stannic chloride *with* **MCl.**
See **Chlorostannate, M.**

Stannous chloride ammonia, $SnCl_2$, NH_3.
(Berzelius.)

Stannic chloride ammonia, $SnCl_4$, $2NH_3$.

Sol. in cold H_2O without decomp., but decomposes by heating.

Stannous chloride arsenate.
See **Arsenate chloride, stannous.**

Stannic chloride cyanhydric acid, $SnCl_4, 2HCN$.

Decomp. on moist air or with H_2O. (Klein, A. **74.** 85.)

Stannic chloride phosphine, $3SnCl_4, 2PH_3$.

Decomp. by H_2O. (Rose, Pogg. **24.** 159.)

Stannous chloride potassium stannous sulphate.

See **Sulphate, potassium stannous stannous chloride.**

Stannic chloride sulphide, $2SnCl_4, SnS_2$.

See **Stannic sulphochloride.**

Stannic chlorobromide, $SnClBr_3$.

Decomp. by H_2O. (Ladenburg, A. suppl. **8.** 60.)

$SnCl_2Br_2$. Decomp. by H_2O. (Ladenburg.)

Stannous chloroiodide, $SnClI$.

Decomp. immediately by H_2O. (Henry, Phil. Trans. **1845.** 363.)

Stannous fluoride, SnF_2.

Easily sol. in H_2O. (Berzelius, Pogg. **1.** 34.)

Stannic fluoride, SnF_4.

Known only in solution.

Stannic fluoride *with* **MF.**

See **Fluostannate, M.**

Stannous hydroxide, $2SnO, H_2O$.

Decomp. to SnO when boiled with H_2O. More easily sol. in acids than Sn or SnO. Sol. in $NaOH$, and $KOH+Aq$, even when dil. Insol. or very sl. sol. in NH_4OH, $(NH_4)_2CO_3$, and K_2CO_3+Aq; sol. in cold CaO_2H_2, and BaO_2H_2 with decomposition on boiling. (Fremy, A. ch. (3) **12.** 460.) Only sl. sol. in NH_4Cl+Aq, hot or cold. (Brett.) Sl. sol. in $NaC_2H_3O_2+Aq$. (Mercer.)

Not pptd. in presence of Na citrate. (Spiller.)

Sol. in water-glass $+Aq$. (Ordway.)

Tin hydroxide, $SnO, 6SnO_2+5H_2O$.

$+9H_2O$. (Schiff, A. **120.** 153.)

Tin *sesqui***hydroxide,** Sn_2O_3, xH_2O.

Insol. in H_2O. Sol. in NH_4OH+Aq. (Fuchs, J. pr. **5.** 318.)

Stannic hydroxide.

See **Stannic acid.**

Tin hydroxyl chloride, $SnO(OH)Cl$.

See **Chlorostannic acid.**

Stannous iodide, SnI_2.

Sl. sol. in cold, more abundantly in hot H_2O, without decomp. Sol. in $SnCl_2+Aq$. Sol. in warm alkali chlorides or iodides $+Aq$; also in dil. $HCl+Aq$. Very sl. sol. in $CHCl_3$, CS_2, or C_6H_6. (Personne, C. R. **54.** 216.)

Sol. in $KOH+Aq$. (Rose.)

Stannic iodide, SnI_4.

Decomp. by H_2O into SnO_2 and HI. Sol. in anhydrous alcohol, ether, and benzene. 1 pt. CS_2 dissolves 1·45 pts. SnI_4 at ordinary temp. (Schneider, Pogg. **127.** 624.)

100 pts. methylene iodide CH_2I_2 dissolve 22·9 pts. SnI_4 at 10°. Sp. gr. of solution = 3·481. (Retgers, Z. anorg. **3.** 343.)

Stannous iodide ammonia, $SnI_2, 2NH_3$ (?).

(Rammelsberg, Pogg. **48.** 109.)

Stannic iodide ammonia, $SnI_4, 3NH_3$.

(Personne, C. R. **54.** 218.)

$SnI_4, 4NH_3$. (Personne.)

$SnI_4, 8NH_3$. (Rammelsberg, Pogg. **48.** 169.)

Tin iodosulphide.

See **Tin sulphoiodide.**

Tin *mon***oxide (Stannous oxide),** SnO.

Insol. in H_2O. Sol. in acids. Very sl. sol. in boiling NH_4Cl+Aq. (Rose.) Insol. in $NaOH$ or $KOH+Aq$.

Tin *di***oxide (Stannic oxide),** SnO_2.

Insol. in H_2O or conc. acids except conc. H_2SO_4. Insol. in conc. alkalies or NH_4OH+Aq.

Not absolutely insol. in dil. HNO_3+Aq. (Mulder.)

Min. *Cassiterite* (*Tin stone*). Not attacked by acids.

Tin *sesqui***oxide,** Sn_2O_3.

While moist, easily sol. in NH_4OH+Aq. Sl. sol. in dil., more easily in conc. $HCl+Aq$. (Berzelius.)

Stannic oxybromide, $Sn_3Br_6O+12H_2O$.

Decomp. by H_2O into $SnBr_2$ and H_2SnO_3.

$Sn_3Br_8O_2$. As above. (Preis and Raymann, C. C. **1882.** 773.)

Stannous oxychloride, $SnO, SnCl_2+3H_2O$.

Insol. in H_2O. Sol. in HCl, $HC_2H_3O_2$, and dil. HNO_3, or H_2SO_4+Aq. (J. Davy, Schw. J. **10.** 325.)

$Sn_8Cl_{14}O_8+10H_2O$. Easily sol. in H_2O or alcohol.

Can be recrystallised from alcohol but not from H_2O. (Tschermak, W. A. B. **44, 2.** 736.)

Stannic oxychloride, $SnO_2, SnCl_4$.

Sol. in H_2O. (Scheurer-Kestner, A. ch. (3) **47.** 6.)

*Meta***stannic oxychloride,** $3SnO_2, SnCl_4+3H_2O$.

Sol. in little, decomp. by much H_2O. (Weber, Pogg. **122.** 368.)

$4SnO_2, SnCl_4+7H_2O$. (Weber.)

Stannous oxyiodide, $SnO, 3SnI_2$; $2SnO, 3SnI_2$; SnO, SnI_2; and $2SnO, SnI_2$.

Decomp. by much H_2O. (Personne, C. R. **54.** 216.)

Tin phosphide, SnP.

Sol. in $HCl+Aq$. Insol. in HNO_3+Aq.

Sn_3P_2.

Sn_9P.

Tin phosphochloride, $Sn_3P_2Cl_6$.

(Mahn, Jena. Zeit. **5.** 160.)

Stannous selenide, $SnSe$.

Decomp. by boiling $HCl+Aq$. Slowly oxidised by boiling HNO_3+Aq, and easily dissolved in aqua regia (Schneider, Pogg. **127.**

624). Easily sol. in alkalies + Aq (Uelsmann, A. **116.** 122), or scarcely attacked even on boiling (Schneider), according to method of preparation. Sol. in alkali sulphides or selenides + Aq.

Stannic selenide, $SnSe_2$.

Not attacked by H_2O or dil. acids; scarcely attacked by boiling conc. HCl + Aq; gradually decomp. by hot HNO_3 + Aq; easily dissolved by warm aqua regia, and hot conc. H_2SO_4.

Sol. in cold, more easily in warm KOH, NaOH, or NH_4OH + Aq. (Uelsmann, A. **116.** 122.)

Stannous sulphide, SnS.

Insol. in dil., sol. in conc. HCl + Aq. Sl. sol. in hot conc. HNO_3 + Aq. Insol. in KOH + Aq.

+ H_2O. Insol. in H_2O, H_2S + Aq, or dil. acids; sol. with decomp. in conc. acids; easily sol. in hot conc. HCl + Aq. Insol. in H_2SO_3 + Aq. Insol. in NH_4OH + Aq. Insol. in NH_4Cl, or NH_4NO_3 + Aq. Scarcely sol. in $(NH_4)_2S$ + Aq, but easily sol. in the same on addition of S. (Rose.)

Sol. in alkali polysulphides + Aq.

Stannic sulphide, SnS_2.

Anhydrous. (*Mosaic gold.*) Insol. in HCl or HNO_3 + Aq, but decomp. by aqua regia. Sol. in hot KOH + Aq or K_2CO_3 + Aq; also in hot K_2S, Na_2S + Aq, and $(NH_4)_2S$ + Aq.

+ xH_2O. Sl. sol. in NH_4OH + Aq, but readily in KOH, K_2S, or Na_2S + Aq; also in hot conc. HCl + Aq. Decomp. by hot HNO_3 + Aq. Insol. in $KHSO_3$ + Aq. Sol. in K_2CO_3 + Aq. Insol. in NH_4Cl, and NH_4NO_3 + Aq. (Brett.)

H_2S ceases to ppt. Sn in presence of 120,000 pts. H_2O. (Pfaff.)

Sol. in boiling conc. $H_2C_2O_4$ + Aq. (Clarke, C. N. **21.** 124.)

Tin sulphochloride, SnS_2, $2SnCl_4$.

H_2O dissolves out $SnCl_4$. (Dumas, Schw. J. **66.** 409.)

$SnS_2Cl_{12} = SnCl_4$, $2SCl_4$. Sol. in H_2O with separation of S.

Gradually sol. in dil. HNO_3 + Aq.

Sol. in $POCl_3$. (Casselmann, A. **83.** 267.)

Tin sulphoiodide, SnS_2I_4.

Decomp. by H_2O into SnO_2, S, and HI; by cold conc. HCl + Aq with separation of S, also by aqua regia, and HNO_3 + Aq.

Cold KOH + Aq separates S and SnO_2.

Completely sol. in hot KOH + Aq.

Sol. in cold, more easily in hot CS_2 or $CHCl_3$.

Decomp. by alcohol. (Schneider, Pogg. **111.** 249.)

Stannous telluride, SnTe.

Not attacked by conc. HCl + Aq. (Ditte, C. R. **97.** 42.)

Titanic acid, TiO_2, xH_2O.

α-Titanic acid.—Insol. in H_2O or alcohol. When dried in the cold, is completely sol. in acids, especially HCl, or dil. H_2SO_4 + Aq, but when the solution in acids is boiled, it is converted into β-titanic acid. Very sl. sol. even when moist in H_2SO_3 + Aq. (Berthier.) Sl. sol. in alkali carbonates + Aq. A complete solution in an alkali carbonate + Aq can only be obtained by adding a Ti salt drop by drop to the alkaline solution, and allowing the ppt. to dissolve entirely before adding more Ti salt. On boiling the solution in $(NH_4)_2CO_3$ + Aq (or in K_2CO_3 or Na_2CO_3 + Aq with NH_4Cl) the titanic acid is pptd.

β-Titanic acid, Metatitanic acid.—Insol. in H_2O, acids except HF, or alkali hydrates or carbonates + Aq. When digested with conc. H_2SO_4 until acid is evaporated, the residue is sol. in H_2O. (Berzelius.)

γ-Titanic acid.—Sol. in pure H_2O, but β-acid is pptd. by boiling. (Knop, A. **123.** 351.)

Colloidal TiO_2, xH_2O + Aq has been prepared by Graham (Chem. Soc. **17.** 325).

Barium titanate, 2BaO, $3TiO_2$.

(Bourgeois, C. R. **103.** 141.)

Calcium titanate, $CaTiO_3$.

(Ebelmen, C. R. **32.** 711.)

Min. *Perofskite.* Scarcely attacked by HCl + Aq or other acids, except hot H_2SO_4, which decomposes it.

CaO, $2TiO_2$. Min. *Titanomorphite.* Partially decomp. by HCl + Aq, completely by H_2SO_4.

Ferrous *ortho*titanate, Fe_2TiO_4.

(Hautefeuille, C. R. **59.** 733.)

Ferroferric titanate, $FeTiO_3$, xFe_2O_3.

Min. *Menaccanite.* Very sl. sol. in HCl or aqua regia with separation of TiO_2.

Ferric titanate.

Not attacked by boiling H_2SO_4 or conc. HCl + Aq. (Wöhler and Liebig, Pogg. **21.** 578.)

Magnesium titanate, $MgTiO_3$.

Insol. in H_2O and acids. (Hautefeuille, A. ch. (4) **4.** 169.)

Mg_2TiO_4. Slowly decomp. by boiling with HNO_3 + Aq. (Hautefeuille, A. ch. (4) **4.** 169.)

Potassium titanate, K_2TiO_3.

Anhydrous. Decomp. with H_2O.

+ $4H_2O$. Deliquescent. Very sol. in H_2O. Precipitated from aqueous solution by alcohol. (Demoly, Compt. chim. **1849.** 325.)

Potassium titanate, acid, K_2O, $3TiO_2 + 2H_2O$.

Insol. in H_2O. (Demoly.)

K_2O, $6TiO_2 + 2H_2O$. (Demoly.)

K_2O, $3TiO_2 + 3H_2O$. Insol. in H_2O. Completely sol. in HCl + Aq if only cold H_2O is used for washing. When heated to 100°, no longer completely sol. in HCl + Aq. (Rose, Pogg. **74.** 563.)

K_2O, $12TiO_2$. (Rose, Gilb. Ann. **73.** 78.)

Sodium titanate, Na_2TiO_3.

Anhydrous. Decomp. by H_2O into NaOH, and an acid titanate, insol. in H_2O.

+ $4H_2O$. Deliquescent. Very sol. in H_2O. Precipitated from aqueous solution by alcohol. (Demoly.)

Sodium titanate, acid, $2Na_2O, 9TiO_2+5H_2O$.

If not heated to 100°, is sol. in cold $HCl+Aq$. (Rose, Gilb. Ann. **73**. 78.)

$2Na_2O, 3TiO_2$. Insol. in H_2O; slowly sol. in cold, easily in hot $HCl+Aq$. (Cormimbœuf, C. R. **115**. 823.)

$Na_2O, 2TiO_2$. As above. (C.)

$Na_2O, 3TiO_2$. Insol. in H_2O, and nearly so in boiling $HCl+Aq$. (C.)

Strontium titanate, $2SrO, 3TiO_2$.

(Bourgeois, C. R. **103**. 141.)

Zinc titanate, ZnO, TiO_2 (?).

(Lévy, A. ch. (6) **24**. 456.)

$2ZnO, TiO_2$ (?). (Lévy.)

$3ZnO, 2TiO_2$. Slowly attacked by warm H_2SO_4 or HNO_3+Aq, and by H_2SO_4+HF. Wholly sol. in cold $HCl+Aq$. (Lévy.)

$4ZnO, 5TiO_2$. Not attacked by cold conc. acids, but sol. by boiling except in $HCl+Aq$. (Lévy.)

$ZnO, 3TiO_2$. Insol. in H_2O, alcohol, or ether. Dil. HNO_3, H_2SO_4, or $HCl+Aq$ do not attack even on boiling; boiling H_2SO_4 dissolves with difficulty; not attacked by conc. boiling alkalies+Aq. (Lévy, A. ch. (6) **25**. 471.)

Titanium, Ti.

Decomp. H_2O even under 100° (Wöhler); not attacked by H_2O under 500° (Kern, C. N. **33**. 57).

Sol. in $HCl+Aq$ if warmed. Sol. in cold dil. H_2SO_4+Aq, HNO_3+Aq, or $HC_2H_3O_2+Aq$. Dissolves almost instantaneously in $HF+Aq$. (Merz.)

Titanium bromide, $TiBr_4$.

Deliquescent. Decomp. by H_2O. (Duppa, C. R. **42**. 352.)

Titanium carbide, TiC.

Sol. in HNO_3+Aq. (Shimer, C. N. **55**. 71.)

Titanium carbide nitride, $Ti_{10}C_2N_8=Ti(CN)_2, 3Ti_3N_2$.

Insol. in, and not attacked by boiling HNO_3 or H_2SO_4 (Wollaston), but sol. in HNO_3+HF (Berzelius).

Titanium ***di*****chloride**, $TiCl_2$.

Very deliquescent. Decomposes H_2O with violence. Insol. in ether, CS_2, or $CHCl_3$. Decomp. by 99·5 % alcohol.

Titanium ***tri*****chloride**, $TiCl_3$.

Deliquescent. Sol. in H_2O with evolution of heat.

$+4H_2O$. (Glatzel, B. **9**. 1829.)

Titanium ***tetra*****chloride**, $TiCl_4$.

Anhydrous. Sol. in H_2O with evolution of much heat.

$+5H_2O$. Deliquescent.

Titanium sulphuryl chloride, $TiCl_4SO_3=TiCl_3OSO_2Cl$.

Deliquesces gradually in moist air. (Clausnitzer, B. **11**. 2011.)

Titanium chloride ammonia, $TiCl_4, 4NH_3$.

Deliquescent. Solution in H_2O is not quite clear. (Rose.)

According to Persoz (A. ch. **46**. 315), is $TiCl_4, 6NH_3$.

Titanium chloride cyanhydric acid, $TiCl_4, 2HCN$.

Deliquescent. Sol. in H_2O with evolution of heat. (Wöhler, A. **73**. 226.)

Titanium chloride phosphine.

Decomp. by H_2O, $HCl+Aq$, $KOH+Aq$, or K_2CO_3+Aq, or $(NH_4)_2CO_3+Aq$. (Rose.)

Titanium ***di*****fluoride.**

(Hautefeuille, C. R. **57**. 151.)

Probably *sesqui*fluoride.

Titanium ***sesqui*****fluoride**, Ti_2F_6.

Appears to be two modifications, one sol. in H_2O, and the other insol. in H_2O. (Hautefeuille, C. R. **59**. 189.)

Insol. in H_2O. (Weber, Pogg. **120**. 291.)

Titanium ***tetra*****fluoride**, TiF_4.

Decomp. by H_2O. (Unverdorben.)

Sol. in H_2O, but solution decomp. upon evaporation. (Marignac, Ann. Min. (5) **15**. 258.)

$+xH_2O$. Decomp. by H_2O. (Berzelius.)

Titanium hydrogen fluoride, $2HF, TiF_4=H_2TiF_6$.

Sol. in H_2O with decomposition and separation of a basic salt. Corresponds to fluosilicic acid, and may be considered as fluotitanic acid H_2TiF_6.

Titanium fluoride ***with*** **MF.**

See **Fluotitanate, M.**

Titanium ***sesqui*****hydroxide,** Ti_2O_3, xH_2O.

Decomposes very quickly with H_2O, forming titanium *di*hydroxide.

Titanium ***di*****hydroxide.**

See **Titanic acid.**

Titanium hydroxychloride, $TiCl_3(OH)$.

Deliquescent. Easily sol. in H_2O and alcohol. Sol. in ether.

$TiCl_2(OH)_2+1\frac{1}{2}H_2O$. Deliquescent. Sol. in H_2O, alcohol, and ether. Aqueous solution decomp. by boiling.

$TiCl(OH)_3+H_2O$. Nearly insol. in H_2O. Insol. in alcohol and ether. (König and v. der Pfordten, B. **21**. 1708.)

See also **Titanium oxychloride.**

Titanium iodide, TiI_4.

Fumes on air, and dissolves rapidly in H_2O with evolution of heat. Solution decomposes on standing. (Weber.)

Titanium nitride, Ti_5N_6.

(Wöhler, A. **73**. 46.)

Ti_3N_4. Difficultly sol. in warm HNO_3+Aq. More easily sol. in aqua regia. (Rose.)

TiN_2. Insol. in H_2O. (Wöhler.)

Is TiN, according to Guerin (C. R. **82**. 972).

Titanium *sesqui*oxide, Ti_2O_3.

Insol. in HCl or HNO_3+Aq. Difficultly sol. in H_2SO_4. (Ebelmen, A. ch. (3) **20.** 392.)

When moist, insol. in H_2O or NH_4OH+Aq, but quickly decomp. to TiO_2. Sol. in oxygen acids, but quickly decomp. (Berzelius.)

Titanium *di*oxide, TiO_2.

Amorphous. Insol. in H_2O, HCl, or dil. H_2SO_4+Aq, even when heated for a long time. Sol. in conc. H_2SO_4 by long digestion.

Crystalline. Min. *Rutile*, *Brookite*, and *Anatase*. Solubility as above.

See also **Titanic acid.**

Titanium oxide, Ti_3O_5.

(Deville, C. R. **53.** 163.)

True formula is Ti_7O_{12}. (v. der Pfordten, A. **237.** 201.)

Titanium *per*oxide, TiO_3.

Sol. in acids. Solution in H_2SO_4 is very stable, but the HCl solution decomposes very easily. (Weber, B. **15.** 2599; Piccini, B. **15.** 2221; Classen, B. **21.** 370.)

Titanium oxychloride, TiO_2, $TiOCl_2+8H_2O$.

Sol. in much H_2O. (Merz, Bull. Soc. **1867.** 401.)

$Ti_2O_3Cl_2$. Insol. in H_2O. Sol. in NH_4OH+Aq with separation of TiO_2.

See also **Titanium hydroxychloride.**

Titanium oxyfluoride.

Insol. in H_2O. (Berzelius.)

Titanium oxyfluoride *with* MF.

See **Fluoxypertitanate, M.**

Titanium phosphochloride.

See **Phosphorus titanium chloride.**

Titanium *mono*sulphide, TiS.

Insol. in alkalies. Difficultly sol. in nitric acid and aqua regia.

Insol. in HF. (v. der Pfordten, A. **234.** 257.)

Titanium *di*sulphide, TiS_2.

Decomp. slowly on moist air. Insol. in HCl or dil. H_2SO_4+Aq. (Ebelmen.)

Sol. in aqua regia or HNO_3+Aq. Decomp. by KOH+Aq or NaOH+Aq. Insol. in KSH+Aq. (Rose.)

Sol. in HF at 100°. (v. der Pfordten, A. **234.** 257.)

Titanium *sesqui*sulphide, Ti_2S_3.

Insol. in caustic alkalies+Aq. Sol. in HF at a high temp. Insol. in aqua regia. (v. der Pfordten, A. **234.** 257.)

Titano*deci*tungstic acid, $H_8TiW_{10}O_{36}+xH_2O$.

(Lecarme, Bull. Soc. (2) **36.** 17.)

Titanotungstic acid *or* **Titano*duodeci*tungstic acid**, $H_8TiW_{12}O_{42}+xH_2O$.

(Lecarme, Bull. Soc. (2) **36.** 17.)

Titanous acid.

Sodium titanite, $Na_2TiO_3=3Na_2O$, Ti_2O_3.

Sol. in dil. acids. (Koenig and v. der Pfordten, B. **22.** 2075.)

Titanyl compounds.

See **Titanium oxy- compounds.**

Triamine cobaltic compounds.

See **Dichrocobaltic compounds.**

Trithionic acid, $H_2S_3O_6$.

Known only in aqueous solution.

Solution in H_2O gradually decomposes in the cold, rapidly at 80°. Not decomp. if very dilute or in presence of acids, except HNO_3, $HClO_3$, and HIO_3. (Fordos and Gélis, A. ch. (3) **28.** 451.)

Trithionates.

The trithionates are all sol. in H_2O, and very easily decomposed.

Barium trithionate, $BaS_3O_6+2H_2O$.

Very sol. in H_2O. Precipitated from aqueous solution by large excess of alcohol. Aqueous solution is very unstable. (Kessler, Pogg. **74.** 250.)

Lead trithionate, PbS_3O_6.

Very sl. sol. in H_2O. Sol. in $Na_2S_2O_3$+Aq. (Fogh, C. R. **110.** 524.)

Potassium trithionate, $K_2S_3O_6$.

Sol. in H_2O. Insol. in alcohol. (Kessler, Pogg. **74.** 270.)

Sodium trithionate, $Na_2S_3O_6$.

Very sol. in H_2O.

$+3H_2O$. (Villiers, C. R. **106.** 1356.)

Thallous trithionate, $Tl_2S_3O_6$.

Sol. in H_2O. (Bevan, C. N. **38.** 294.)

Zinc trithionate.

Sol. in H_2O, but decomposes upon warming the solution. (Fordos and Gélis, C. R. **16.** 1070.)

Tungsten, W.

Metallic. Not attacked by heating with fuming HNO_3, aqua regia, or other acids, or by boiling KOH+Aq. Sol. in KOH+Aq and NaClO+Aq. (v. Uslar, A. **94.** 255.)

Crystalline. Insol. in H_2O, HCl, or H_2SO_4. Oxidised by HNO_3 or aqua regia. (D'Elhujar.)

Sol. in boiling KOH+Aq. (Riche, A. ch. (3) **50.** 5.)

Amorphous. Easily oxidised by HNO_3+Aq. (Zettnow.)

Tungsten amide.

See **Tungsten nitride.**

Tungsten *di*bromide, WBr_2.

Partly sol. in H_2O, the rest decomposing to WO_2 and HBr.

Tungsten *penta*bromide, WBr_5.

Decomp. by moist air or H_2O. Sol. in caustic alkalies+Aq.

Tungsten bronze.

See—
Tungstate tungsten oxide, sodium.
Tungstate tungsten oxide, potassium.
Tungstate tungsten oxide, lithium.

Tungsten *di*chloride, WCl_2.

Decomp. on the air or with H_2O. (Roscoe.)

Tungsten *tetra*chloride, WCl_4.

Deliquescent. Partly sol. in H_2O, with subsequent decomposition. (Roscoe.)

Tungsten *penta*chloride, WCl_5.

Very deliquescent. Decomp. with H_2O with hissing and evolution of heat and separation of W_2O_5.

Very sl. sol. in CS_2. (Roscoe.)

Tungsten *hexa*chloride, WCl_6.

Not decomp. by moist air or H_2O. Decomp. by alcohol. Very sol. in CS_2. (Roscoe.)

Easily sol. in $POCl_3$. (Teclu, A. **187**. 255.)

Tungsten *di*iodide, WI_2.

Not decomp. by H_2O. (Roscoe, A. **162**. 366.)

***Tri*tungsten nitride**, W_3N_2.

(Uhrlaub.)

Tungsten nitride amide, $W_3N_6H_4 = 2WN_2, W(NH_2)_2$.

Not attacked by acids or caustic alkalies + Aq. (Wöhler, A. **73**. 191.)

Tungsten nitride amide oxide, $W_7N_8H_4O_4 = 3WN_2, W_2(NH_2)_2, 2WO_3$.

Not attacked by acids or alkalies. (Wöhler.)

Tungsten *mon*oxide, WO.

Insol. in H_2O. Not attacked by HCl, HF, H_2SO_4, or KOH + Aq. HNO_3 + Aq or aqua regia convert it into WO_3. (Headden, Sill. Am. J. **145**. 280.)

Tungsten *di*oxide, WO_2.

(*a*) When prepared in the dry way, is attacked only by aqua regia, which oxidises to WO_3.

(*b*) When moist, is sol. in HCl or H_2SO_4 + Aq, also in KOH + Aq. Insol. in NH_4OH + Aq. (Riche, A. ch. (3) **50**. 5.)

Tungsten oxide, blue.

W_2O_5 (Riche, A. ch. (3) **50**. 33); W_3O_8 (v. Uslar); W_4O_{11} (Gmelin).

All are probably the same substance. Not attacked by boiling HNO_3 or aqua regia. Slowly sol. in boiling KOH + Aq.

Tungsten *tri*oxide, WO_3.

Insol. in H_2O or acids. Sl. sol. in dil. KOH + Aq, NaOH + Aq, Na_2CO_3 + Aq, or H_2CO_3 + Aq, but easily sol. in conc. boiling solutions of above. NH_4OH + Aq when boiling has a solvent action.

Min. *Tungstite*. Insol. in acids. Sol. in NH_4OH + Aq.

Tungsten oxybromide, etc.

See **Tungstyl bromide, etc.**

Tungsten phosphide, W_4P_2.

Not attacked by any acid, not even by aqua regia. (Wöhler and Wright, A. **79**. 244.)

W_3P_4.

Tungsten *di*selenide, WSe_2.

(Uelsmann.)

Tungsten *tri*selenide, WSe_3.

Easily sol. in alkalies, alkali sulphides or selenides + Aq. (Uelsmann, Jahrb. f. Ch. **1860**. 92.)

Tungsten *di*sulphide, WS_2.

Oxidised by HNO_3 + Aq. (Berzelius.)

Tungsten *tri*sulphide, WS_3.

Somewhat sol. in cold, abundantly in hot H_2O, but separated out by the addition of salts, especially NH_4Cl, or acids. Sol. in alkali sulphides, and hydrosulphides + Aq. Sol. in caustic alkalies, and alkali carbonates + Aq. Slowly sol. in NH_4OH + Aq in the cold.

Tungstic acid, H_2WO_4.

Insol. in H_2O. Sol. in HF. Insol. in tungstates + Aq.

H_4WO_5. Precipitate. Sl. sol. in H_2O and aqueous solutions of the tungstates. Sol. in 250-300 pts. H_2O. When freshly pptd. sol. in alkali hydrates or carbonates + Aq. (Anthon, J. pr. **9**. 6.)

*Meta*tungstic acid, $H_2W_4O_{13} + 7H_2O$.

Sol. in H_2O. Solution may be boiled and evaporated to a syrupy consistency, when it suddenly gelatinises and ordinary tungstic acid is precipitated.

Sp. gr. of solution of metatungstic acid at 17·5° containing:

2·79	12·68	27·61	43·75 % WO_3.
1·0257	1·1275	1·3274	1·6343

(Scheibler, J. pr. **83**. 273.)

Sp. gr. of aqueous solution calculated by M = Mendelejeff, and G = Gerlach (Z. anal. **27**. 300), containing:

	5	10	15	20	25 % WO_3,
M	1·047	1·098	1·153	1·214	1·285
G	1·0469	1·0980	1·1544	1·2172	1·2873
	30	35	40	45	50 % WO_3.
M	1·366	1·458	1·555	1·581 (?)	
G	1·3660	1·4540	1·5527	1·6630	1·7860

Colloidal. Sol. in H_2O. Not precipitated by acids or alcohol. Can be evaporated to dryness and heated to 200°, and still remains sol. in H_2O. Sol. in $\frac{1}{4}$ pt. of H_2O.

Sp. gr. of aqueous solution containing:

5	20	50	66·5	79·8 % WO_3.
1·0475	1·2168	1·8001	2·596	3·243

(Graham, Chem. Soc. **17**. 318.)

Perhaps *para*tungstic acid, $H_{10}W_{12}O_{41}$. (Klein, Bull. Soc. (2) **36**. 547.)

Tungstates.

Few normal tungstates are sol. in H_2O, even some of the K and NH_4 salts are very sl. sol.

Most of the metatungstates, however, are easily sol. in H_2O.

Tungstates insol. in H_2O are usually insol. in dil. acids.

Aluminum tungstate, $Al_2(WO_4)_3+8H_2O$.

Precipitate. Insol. in H_2O and Na_2WO_4+ Aq. Sol. in $(NH_4)_2Al_2(SO_4)_4+$ Aq, $NaOH+$ Aq, NH_4OH+ Aq.

Easily sol. in H_3PO_4, $H_2C_2O_4$, and $H_2C_4H_4O_6+$ Aq. (Lotz, A. **83.** 65.)

Sol. in 1500 pts. H_2O at 15°. (Lefort, C. R. **87.** 748.)

Al_2O_3, $4WO_3+9H_2O$. Sol. in 400 pts. H_2O at 15°. (Lefort, C. R. **87.** 748.)

Al_2O_3, $5WO_3+6H_2O$. Sol. in H_2O, from which it is pptd. by alcohol. (Lefort.)

Formula according to Lefort is Al_2O_3, $3WO_3+3H_2O$, $2WO_3$.

Aluminum *para*tungstate, $5Al_2O_3$, $36WO_3+46H_2O=Al_2O_3$, $7WO_3+9H_2O$ (?).

Easily sol. in an alum solution. (Lotz, A. **83.** 65.)

Ammonium tungstate, $(NH_4)_2WO_4$.

Known only in solution.

$(NH_4)_4W_3O_{11}+3H_2O=2(NH_4)_2O$, $3WO_3+3H_2O$. Sol. in H_2O with decomp. Decomp. on air with evolution of NH_3, and formation of *para*tungstate. Sol. in NH_4OH+ Aq. (Marignac, A. ch. (3) **69.** 23.)

$(NH_4)_4W_5O_{17}+5H_2O=2(NH_4)_2O$, $5WO_3+5H_2O$. Sol. at ordinary temp. in 26-29 pts. H_2O with partial decomposition. (Marignac.)

$(NH_4)_6W_8O_{27}+8H_2O=3(NH_4)_2O$, $8WO_3+8H_2O$. Sol. in H_2O. (Marignac.)

Ammonium *meta*tungstate, $(NH_4)_2W_4O_{13}$.

$+6H_2O$. (Marignac, A. ch. (4) **3.** 74.)

$+8H_2O$. Efflorescent. Very sol. in H_2O.

1 pt. dissolves at 15° in 0·84 pt. H_2O. (Lotz.)

1 pt. dissolves at ordinary temp. in 0·35 pt. H_2O. (Riche.)

Solubility increases rapidly with the temperature.

Saturated solution at 40° is solid on cooling.

Sl. sol. in ordinary, insol. in absolute alcohol. (Lotz.) Insol. in ether. (Riche.)

[$(NH_4)_2W_3O_{10}+5H_2O$ of Margueritte.]

$(NH_4)_6W_{16}O_{51}+17H_2O=3(NH_4)_2O$, $16WO_3+17H_2O$. Very efflorescent. Decomp. by dissolving in pure H_2O. (Marignac, A. ch. (4) **3.** 75.)

Ammonium *para*tungstate, $(NH_4)_{10}W_{12}O_{41}=5(NH_4)_2O$, $12WO_3$.

(Marignac, A. ch. (3) **69.** 25.)

According to Lotz (A. **91.** 49) and Scheibler (J. pr. **80.** 208), formula is $(NH_4)_6W_7O_{24}=3(NH_4)_2O$, $7WO_3$.

$+5H_2O$. (Scheibler, J. pr. **48.** 232.)

$+11H_2O$. Sol. in 25-28 pts. cold H_2O. (Anthon.)

Sol. in 26·1 pts. H_2O at 10·7°, and 5·8 pts. at 100°. (Lotz.)

Sol. in 33·3 pts. cold H_2O, and 9·6 pts. at 100°. (Riche.)

Sol. in 22-38 pts. H_2O at 15-18°. The solution gradually decomposes, with the formation of a more soluble salt. (Marignac.)

Not much more sol. in NH_4OH+ Aq than in H_2O. Insol. in alcohol. (Anthon.)

Ammonium cadmium *para*tungstate, $3(NH_4)_2O$, $12CdO$, $35WO_3+35H_2O$.

Ppt. Sol. in H_2O acidulated with HNO_3. (Lotz, A. **91.** 49.)

Ammonium cobaltous tungstate, $8(NH_4)_2O$, $2CoO$, $15WO_3+3H_2O$.

(Carnot, C. R. **109.** 147.)

Ammonium ferric tungstate, $5(NH_4)_2O$, Fe_2O_3, $5WO_3+5H_2O$.

Sol. in H_2O. (Borck.)

Ammonium magnesium *para*tungstate, $2(NH_4)_2O$, $3MgO$, $12WO_3+24H_2O$.

Very slightly sol. in H_2O. (Marignac, A. ch. (3) **69.** 58.)

$(NH_4)_2O$, $2MgO$, $7WO_3+10H_2O$. Very sl. sol. in H_2O; sol. in H_2O acidulated with HNO_3. (Lotz.)

Ammonium mercuric tungstate, $(NH_4)_2WO_4$, $HgWO_4+H_2O$.

Insol. in H_2O. Decomp. by acids or alkalies. (Anthon.)

Ammonium sodium *para*tungstate, $4(NH_4)_2O$, Na_2O, $12WO_3+5H_2O$.

Can be crystallised from H_2O without decomp. (Lotz, A. **91.** 57.)

$+14H_2O$. (Knorre, B. **19.** 822.)

$5Na_2O$, $15(NH_4)_2O$, $48WO_3+48H_2O$. (Marignac, A. ch. (3) **69.** 53.)

$2Na_2O$, $3(NH_4)_2O$, $12WO_3+15H_2O$. (Marignac.)

$4Na_2O$, $16(NH_4)_2O$, $50WO_3+50H_2O$. Sl. sol. in cold H_2O. (Gibbs, Proc. Am. Acad. **15.** 12.)

$3Na_2O$, $4(NH_4)_2O$, $16WO_3+18H_2O$. (Gibbs, Am. Ch. J. **7.** 236.)

Is $2Na_2O$, $3(NH_4)_2O$, $12WO_3+13H_2O$, according to Knorre (B. **19.** 823).

Ammonium potassium sodium *para*tungstate, $5(K, Na, NH_4)_2O$, $12WO_3+13H_2O$, where $K:Na:NH_4=3:3:4$.

$10(K, Na, NH_4)_2O$, $24WO_3+26H_2O$, where $K:Na:NH_4=3:3:14$. (Laurent.)

Ammonium zinc *para*tungstate, $(NH_4)_2O$, $2ZnO$, $7WO_3+13H_2O$.

Sl. sol. in boiling H_2O, but more easily on addition of oxalic, tartaric, phosphoric, or dil. nitric acids, or of ammonium tungstate. (Lotz, A. **91.** 49.)

Ammonium *meta*tungstate nitrate.

See **Nitrate *meta*tungstate, ammonium.**

Ammonium tungstate vanadate.

See **Vanadiotungstate, ammonium.**

Antimony tungstate, Sb_2O_3, $5WO_3+4H_2O$.

Sol. in H_2O without decomp. (Lefort.)

Sb_2O_3, $6WO_3+8H_2O$. Ppt.

Barium tungstate, $BaWO_4$.

Anhydrous. Insol. in H_2O. Decomp. by boiling HNO_3+Aq. (Geuther and Forsberg, A. **120**. 270.)

$+\frac{1}{2}H_2O$. Insol. in H_2O or boiling H_3PO_4+Aq. Sol. in boiling, less sol. in cold $H_2C_2O_4$+Aq. (Anthon.)

$+2\frac{1}{2}H_2O$. Insol. precipitate. (Scheibler.)

Pptd. $BaWO_4$ is attacked by dil. acids. More sol. in NH_4NO_3+Aq than in H_2O. (Smith and Bradbury, B. **24**. 2930.)

Barium *di*tungstate, $BaW_2O_7+H_2O$ (?).

Nearly insol. in H_2O. 100 ccm. H_2O dissolve about 0·05 g. at 15°. (Lefort, A. ch. (5) **15**. 325.)

Barium *tri*tungstate, $BaW_3O_{10}+4H_2O$ (?).

Sol. in about 300 pts. H_2O at 15°. Decomp. by boiling H_2O into an insol. salt. (Lefort, C. R. **88**. 798.)

$+6H_2O$. (Scheibler.)

Barium *meta*tungstate, $BaW_4O_{13}+9H_2O$.

Efflorescent. Quite sol. in hot H_2O. Partly decomp. by cold H_2O into BaW_3O_{10} and WO_3, which recombine on heating. (Scheibler, J. pr. **80**. 204.)

Barium tungstate, $BaW_8O_{25}+8H_2O$.

Insol. in H_2O or HCl+Aq. (Zettnow.)

Barium *para*tungstate, $Ba_5W_{12}O_{41}+14H_2O$, or $Ba_3W_7O_{24}+8H_2O$.

Insol. in cold H_2O; when freshly pptd. is sl. sol. in HNO_3+Aq. (Lotz, A. **91**. 60.) Sol. in NH_4Cl+Aq. (Wackenroder.)

$+27H_2O=Ba_3W_7O_{24}+16H_2O$. Insol. in cold, sl. sol. in hot H_2O. (Knorre, B. **18**. 327.)

Barium silver *meta*tungstate.

(Scheibler.)

Barium sodium *para*tungstate, 2BaO, $3Na_2O$, $12WO_3+24H_2O$ (Marignac), or BaO, $2Na_2O$, $7WO_3+14H_2O$ (Scheibler).

Insol. in H_2O.

Bismuth tungstate, Bi_2O_3, $6WO_3+8H_2O$.

Very sol. in H_2O with decomp. Pptd. by alcohol from aqueous solution. (Lefort, C. R. **87**. 748.)

Cadmium tungstate, $CdWO_4$.

Anhydrous.

$+H_2O$. Sol. in about 2000 pts. H_2O. (Lefort.)

$+2H_2O$. Insol. in H_2O. Sol. in hot phosphoric or oxalic acids, or in NH_4OH+Aq. (Anthon, J. pr. **9**. 341.)

Sol. in KCN+Aq. (Smith and Bradbury, B. **24**. 2390.)

Cadmium *di*tungstate, $CdW_2O_7+3H_2O$ (?).

Sol. in about 500 pts. H_2O at 15°. (Lefort, A. ch. (5) **15**. 346.)

Cadmium *tri*tungstate, $CdW_3O_{10}+4H_2O$ (?).

(Lefort.)

Cadmium *meta*tungstate, CdO, $4WO_3+10H_2O$.

Not efflorescent. (Scheibler, J. pr. **83**. 273.)

Cadmium *para*tungstate, $Cd_3W_7O_{24}+16H_2O$.

Ppt. (Gonzalez.)

Insol. in H_2O. Sol. in NH_4OH+Aq, and hot H_3PO_4, $H_2C_2O_4$, or $HC_2H_3O_2$+Aq.

Cadmium sodium *para*tungstate, 2CdO, Na_2O $7WO_3+18H_2O$.

Difficultly sol. in cold H_2O. (Knorre, B. **19**. 824.)

Calcium tungstate, $CaWO_4$.

Insol. in H_2O or dil. acids. Sol. in about 500 pts. H_2O. (Lefort.)

Decomp. by KOH+Aq. (Anthon.)

When freshly pptd., sol. in NH_4Cl+Aq. (Wackenroder.)

Sol. in Mg, and NH_4 salts, also in Na_2WO_4+Aq. (Sonstadt, C. N. **11**. 97.)

Min. *Scheelite.* Decomp. by HCl or HNO_3+Aq, with separation of WO_3.

Calcium *di*tungstate, $CaW_2O_7+3H_2O$ (?).

Sol. in 30 pts. H_2O at 15°. (Lefort, A. ch. (5) **15**. 328.)

Calcium *tri*tungstate, $CaW_3O_{10}+6H_2O$ (?).

Sol. in cold H_2O. (Lefort.)

Calcium *meta*tungstate, $CaW_4O_{13}+10H_2O$.

Easily sol. in H_2O. (Scheibler.)

Calcium *para*tungstate, $Ca_3W_7O_{24}+18H_2O$ (or $Ca_5W_{12}O_{41}+30H_2O$).

Much more sol. than Sr or Ba salt. (Knorre, B. **18**. 328.)

Calcium sodium *para*tungstate, 2CaO, $3Na_2O$, $12WO_3+3H_2O$.

(Gonzalez, J. pr. (2) **36**. 44.)

Cerium tungstate, $Ce_2(WO_4)_3+H_2O$.

Precipitate. (Cossa and Zecchino, Gazz. ch. it. **10**. 225.)

Cerium *meta*tungstate, Ce_2O_3, $12WO_3+30H_2O$.

Permanent. Sol. in H_2O. (Scheibler.)

Cerium sodium tungstate, $Ce_2Na_8(WO_4)_7$.

Insol. in H_2O. Slowly sol. in dil. acids, easily in HCl+Aq. (Högbom, Bull. Soc. (2) **42**. 2.)

$Ce_2(WO_4)_3$, $3Na_2WO_4$. (Didier, C. R. **102**. 823.)

Cerium tungstate chloride, $3Ce_2(WO_4)_3$, $2CeCl_3$.

(Didier, C. R. **102**. 823.)

Chromic tungstate, basic, Cr_2O_3, $2WO_3+5H_2O$.

Sol. in 400 pts. H_2O at 15°. (Lefort, C. R. **87**. 748.)

Chromic tungstate, $Cr_2(WO_4)_3$+7, and $13H_2O$.

Sol. in $CrCl_3$+Aq, and in phosphoric, oxalic, or tartaric acids +Aq. (Lotz.)

$+3H_2O$. (Lefort, C. R. **87**. 748.)

Cr_2O_3, $4WO_3+6H_2O$. Sol. in about 50 pts. H_2O at 15°. (Lefort.)

Cr_2O_3, $5WO_3$. Not attacked by aqua regia. (Smith and Oberholtzer, Z. anorg. **5**. 63.)

Chromic *para*tungstate, $Cr_2W_7O_{24}+9H_2O$.

Insol. in H_2O or NH_4 paratungstate +Aq; sol. in $CrCl_3$+Aq. (Lotz.)

Cobaltous tungstate, $CoWO_4$.

Anhydrous. Insol. in H_2O and acids.

$+2H_2O$. Insol. in H_2O and cold HNO_3+Aq. Sl. sol. in $H_2C_2O_4$+Aq. Completely sol. in warm H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. (Anthon, J. pr. **9.** 344.)

Sol. in about 500 pts. H_2O. (Lefort.)

Cobaltous ***di*****tungstate,** CoW_2O_7 (?).

$+3H_2O$. Insol. in H_2O. Sl. sol. in $H_2C_2O_4$+Aq. Completely sol. in H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. (Anthon.)

$+5H_2O$. Sol. in about 100 pts. H_2O. (Lefort.)

$+8H_2O$ (?). (Lefort.)

Cobaltous ***tri*****tungstate,** $CoW_3O_{10}+4H_2O$ (?).

Sol. in H_2O. (Lefort, C. R. **88.** 798.)

Cobaltous ***meta*****tungstate,** $CoW_4O_{13}+9H_2O$.

Sol. in H_2O. (Scheibler, J. pr. **83.** 317.)

Cobaltous ***para*****tungstate,** $Co_3W_7O_{24}+25H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

Cobaltous sodium ***para*****tungstate,** 2CoO, $3Na_2O$, $12WO_3+30H_2O$.

(Gonzalez.)

Cupric tungstate, $CuWO_4$.

$+2H_2O$. Insol. in H_2O. Sol. in H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. Insol. in $H_2C_2O_4$+Aq. (Anthon.)

100 ccm. H_2O at 15° dissolve 0·1 g. (Lefort.)

Cupric ***di*****tungstate,** CuW_2O_7 (?).

$+4H_2O$. Insol. in H_2O and HNO_3. Sol. in NH_4OH+Aq. (Anthon, J. pr. **9.** 346.)

$+5H_2O$. Sol. in about 300 pts. H_2O. (Lefort.) (?).

Cupric ***meta*****tungstate,** $CuW_4O_{13}+11H_2O$.

Sol. in H_2O. (Scheibler.)

Cupric ***para*****tungstate,** $Cu_3W_7O_{24}+19H_2O$.

Insol. in H_2O. (v. Knorre, B. **19.** 826.)

Cuprocupric tungstate, Cu_2WO_4, $2CuWO_4$.

Insol. in H_2O. (Zettnow, Pogg. **130.** 255.)

Cupric sodium ***para*****tungstate,** $Cu_3Na_6(W_7O_{24})_2+32H_2O$.

Ppt. (Knorre, B. **19.** 826.)

CuO, $4Na_2O$, $12WO_3+32H_2O$. Ppt. (Gonzalez, J. pr. (2) **36.** 52.)

Cupric tungstate ammonia, $CuWO_4$, $2NH_3+H_2O$.

(Schiff, A. **123.** 39.)

Didymium tungstate, $Di_2(WO_4)_3$.

Precipitate. (Frerichs and Smith, A. **191.** 355.)

Didymium ***meta*****tungstate.**

Sol. in H_2O. (Scheibler.)

Didymium sodium tungstate, $DiNa_3(WO_4)_3$.

Insol. in H_2O. Slowly sol. in dil. acids. Sol. in conc. HCl+Aq.

$DiNa(WO_4)_2$. As above. (Högbom, Bull. Soc. (2) **42.** 2.)

Erbium sodium tungstate, $Na_6Er_4(WO_4)_9$.

Insol. in H_2O. (Högbom.)

Glucinum ***meta*****tungstate.**

Very sol. in H_2O.

Ferrous tungstate, $FeWO_4$.

Min. *Ferberite, Reinite.*

$+3H_2O$. Insol. in H_2O. Sol. in cold H_2SO_4, HCl, or HNO_3+Aq. Decomp. by boiling acids with separation of WO_3. Sol. in boiling H_3PO_4+Aq or warm $H_2C_2O_4$+Aq. (Anthon, J. pr. **9.** 343.)

$+xH_2O$. Very unstable. (Lefort, A. ch. (5) **15.** 314.)

Ferrous ***di*****tungstate,** FeW_2O_7 (?).

Insol. in H_2O. Sol. in hot H_3PO_4+Aq or $H_2C_2O_4$+Aq. Decomp. by dil. HCl+Aq or by KOH+Aq. (Ebelmen, C. R. **17.** 1198.)

$+xH_2O$. Very unstable. (Lefort.)

Ferrous ***tri*****tungstate,** $FeW_3O_{10}+4H_2O$ (?).

Ppt. Decomp. by cold, more rapidly by hot H_2O. (Lefort.)

Ferrous ***meta*****tungstate.**

Sol. in H_2O. (Scheibler, J. pr. **83.** 315.)

Ferric tungstate, basic, Fe_2O_3, $2WO_3+4H_2O$.

Sol. in about 50 pts. H_2O. (Lefort.)

$2Fe_2O_3$, $3WO_3+6H_2O$. Sol. in about 300 pts. H_2O at 15°. (Lefort.)

Ferric ***tri*****tungstate** (?), Fe_2O_3, $4WO_3+4H_2O=Fe_2O_3$, $3WO_3+WO_3$, $4H_2O$ (?).

Sol. in H_2O without decomp. (Lefort.)

Ferric ***meta*****tungstate.**

Sol. in H_2O. (Scheibler, J. pr. **83.** 273.)

Ferrous manganous tungstate, $7FeWO_4$, $MnWO_4$.

(Geuther and Forsberg, A. **120.** 277.)

$4FeWO_4$, $MnWO_4$. (G. and F.)

$3FeWO_4$, $MnWO_4$. Partially sol. in conc. HCl+Aq. (G. and F.)

$3FeWO_4$, $2MnWO_4$. (G. and F.)

$FeWO_4$, $MnWO_4$. (Zettnow, Pogg. **130.** 250.)

$FeWO_4$, $2MnWO_4$. (G. and F.)

$FeWO_4$, $7MnWO_4$. (G. and F.)

$xFeWO_4$, $yMnWO_4$. Min. *Wolframite.* Sol. in HCl+Aq, and boiling H_3PO_4+Aq.

Lanthanum tungstate, $La_2(WO_4)_3$.

Precipitate.

Lanthanum ***meta*****tungstate.**

Sol. in H_2O. (Scheibler.)

Lanthanum sodium tungstate, $Na_8La_2(WO_4)_7$.

Insol. in H_2O. Slowly sol. in dil. acids. Sol. in HCl+Aq.

$La_4Na_6(WO_4)_9$. As above. (Högbom, Bull. Soc. (2) **42.** 2.)

Lead tungstate, $PbWO_4$.

Insol. in H_2O or cold HNO_3+Aq. Sol. in KOH+Aq. Decomp. by hot HNO_3+Aq. (Anthon, J. pr. **9.** 342.)

Sol. in about 4000 pts. H_2O. (Lefort.)

Min. *Scheelenite, Stolzite.* Sol. in KOH+Aq; decomp. by HNO_3.

Absolutely insol. in NH_4NO_3+Aq. (Smith and Bradbury, B. **24.** 2930.)

Lead *di*tungstate, $PbW_2O_7+2H_2O$ (?).

Sol. in about 80 pts. H_2O at 15°. (Lefort.)

Lead *tri*tungstate, $PbW_3O_{10}+2H_2O$ (?).

Ppt. (Lefort.)

Lead *meta*tungstate, $PbW_4O_{13}+5H_2O$.

Sl. sol. in cold, more in hot H_2O. Sol. in hot HNO_3+Aq. (Scheibler, J. pr. **83.** 318.)

Lead *para*tungstate, $Pb_3W_7O_{24}$.

Insol. in H_2O, dil. HNO_3+Aq, $(NH_4)_2WO_4$+Aq, or $Pb(NO_3)_2$+Aq. Sol. in NaOH+Aq or boiling H_3PO_4+Aq. (Lotz, A. **91.** 49.)

Lead sodium *para*tungstate, PbO, $4Na_2O$, $12WO_3+28H_2O$.

(Gonzalez.)

Lithium tungstate, Li_2WO_4.

Rather easily sol. in H_2O. (Gmelin.)

Lithium *meta*tungstate, $Li_2W_4O_{13}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27.** 94.)

$+xH_2O$. Syrup. (Scheibler.)

Lithium *para*tungstate, $Li_{10}W_{12}O_{41}+33H_2O$ (or $Li_6W_7O_{24}+19H_2O$).

According to Scheibler, more sol. than the *para*tungstates of the other alkali metals.

Lithium tungstate tungsten oxide, $Li_2W_5O_{15}$.

Lithium bronze. Insol. in H_2O.

Lithium potassium tungstate tungsten oxide, $Li_2W_5O_{15}$, $3K_2W_4O_{12}$.

Lithium potassium bronze. Insol. in H_2O. (Feit, B. **21.** 135.)

Magnesium tungstate, $MgWO_4$.

Anhydrous. Insol. in H_2O. Gradually decomp. by boiling conc. HNO_3+Aq. (Geuther and Forsberg, A. **120.** 272.)

$+3H_2O$. Very sol. in H_2O; nearly insol. in alcohol. (Lefort, A. ch. (5) **15.** 329.)

$+7H_2O$. Slowly sol. in cold, very easily in hot H_2O. (Ullik, W. A. B. **56, 2.** 152.)

Magnesium *di*tungstate, $MgW_2O_7+8H_2O$ (?).

Sol. in about 100 pts. H_2O. (Lefort.)

Magnesium *tri*tungstate, $MgW_3O_{10}+4H_2O$ (?).

Easily sol. in H_2O with gradual decomp. (Lefort.)

Magnesium *meta*tungstate, $MgW_4O_{13}+8H_2O$.

Sol. in H_2O. (Scheibler.)

Magnesium *para*tungstate, $Mg_3W_7O_{24}+24H_2O$.

Very difficultly sol. in cold, somewhat sol. in hot H_2O. (Knorre, B. **19.** 825.)

Magnesium potassium tungstate, $MgWO_4$, K_2WO_4.

$+2H_2O$. Very sl. sol. in H_2O. (Ullik.)

$+6H_2O$. Precipitate.

Magnesium sodium *para*tungstate, 3MgO, $3Na_2O$, $14WO_3+33H_2O$.

Nearly insol. in H_2O. (Knorre, B. **19.** 825.)

Manganous tungstate, $MnWO_4$.

Min. *Hubnerite.* Partially sol. in HCl+Aq.

$+2H_2O$. Insol. in H_2O; sol. in warm H_3PO_4 and $H_2C_2O_4$+Aq; sl. sol. in $HC_2H_3O_2$+Aq. Insol. in cold HCl+Aq. (Anthon.)

$+H_2O$. Sol. in about 2500 pts. H_2O at 15°. (Lefort.)

Manganous *di*tungstate, $MnW_2O_7+3H_2O$ (?).

Sol. in about 450 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 333.)

Manganous *tri*tungstate, $MnW_3O_{10}+5H_2O$ (?).

Decomp. by H_2O into MnW_2O_7 and MnW_4O_{13}. (Lefort, A. ch. (5) **17.** 480.)

Manganous *para*tungstate, 5MnO, $12WO_3+34H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

$Mn_3W_7O_{24}+11H_2O$. When recently pptd. sol. in a small amt. of H_2O acidulated with HNO_3. (Lotz.)

Manganous sodium *para*tungstate, $3Na_2O$, 3MnO, $14WO_3+36H_2O$.

Sol. in H_2O. (Knorre, B. **19.** 826.)

Mercurous tungstate, Hg_2WO_4.

Insol. in H_2O. (Anthon.)

Impossible to obtain pure, as it is decomp. into—

$2Hg_2O$, $3WO_3+8H_2O$. Sol. in 100 pts. H_2O at 15°. (Lefort.)

Mercurous *meta*tungstate, $Hg_2W_4O_{13}+25H_2O$.

Ppt. (Scheibler, J. pr. **83.** 319.)

Mercuric tungstate, $HgWO_4$.

Sl. sol. in H_2O and very unstable. (Lefort, A. ch. (5) **15.** 356.)

3HgO, $2WO_3$. Insol. in H_2O. (Anthon.)

2HgO, $3WO_3$. Insol. in H_2O. (Anthon.)

3HgO, $5WO_3+5H_2O$. Sol. in about 250 pts. H_2O at 15°. (Lefort.)

2HgO, $5WO_3+7H_2O$. Decomp. by hot or cold H_2O. (Lefort, C. R. **88.** 798.)

Mercuric *tri*tungstate, $HgW_3O_{10}+7H_2O$ (?).

Sol. in about 120 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 360.)

Molybdenum tungstate.

Easily sol. in H_2O. Insol. in NH_4Cl+Aq or in alcohol of 0·87 sp. gr. (Berzelius.)

Nickel tungstate, $NiWO_4$.

$+3H_2O$. Sol. in about 1000 pts. H_2O at 15°. (Lefort.)

$+6H_2O$. Insol. in H_2O or $H_2C_2O_4$+Aq. Sol. in boiling H_3PO_4+Aq, $HC_2H_3O_2$+Aq, or in warm NH_4OH+Aq. (Anthon.)

Nickel *di*tungstate, $NiW_2O_7+5H_2O$ (?).

Sol. in about 250 pts. H_2O. (Lefort.)

Nickel *tri*tungstate, $NiW_3O_{10}+4H_2O$ (?).

Sol. in H_2O. Pptd. by alcohol. Decomp. by cold or warm H_2O after above pptn. (Lefort.)

Nickel *meta*tungstate, $NiW_4O_{13}+8H_2O$.

Sol. in H_2O. (Scheibler, J. pr. **83.** 273.)

Nickel *para*tungstate, $Ni_3W_7O_{24}+14H_2O$.

Insol. in H_2O. Sl. sol. in $H_2C_2O_4$+Aq. Completely sol. in warm H_3PO_4 or $HC_2H_3O_2$+Aq. (Anthon.)

Potassium tungstate, K_2WO_4.

Anhydrous. Rather deliquescent. Easily sol. in H_2O.

$+H_2O$. Easily sol. in H_2O. Insol. in alcohol.

$+2H_2O$. Very sol. in H_2O with absorption of heat.

1 pt. dissolves in 1·94 pts. cold, and 0·66 pt. boiling H_2O. Alcohol does not mix with conc. H_2O solution, but slowly separates out the salt from it. Acids, even H_2SO_3, $HC_2H_3O_2$, or $H_2C_2O_4$, separate out WO_3 from solution. (Riche, A. ch. (3) **50.** 45.)

Potassium *di*tungstate, $K_2W_2O_7+2H_2O$.

Sol. in about 8 pts. H_2O at 15°, but on heating is converted into—

$+3H_2O$. 100 pts. H_2O dissolve only 2-3 pts. at 15°. (Lefort, A. ch. (5) **9.** 102.)

Potassium *tri*tungstate, $K_2W_3O_{10}+2H_2O$.

Sol. in 5-6 pts. H_2O at 15°. Can be recryst. from hot H_2O. (Lefort, A. ch. (5) **9.** 105.)

Potassium *meta*tungstate, $K_2W_4O_{13}+5H_2O$.

Not efflorescent. Easily sol. in H_2O. (Marignac.)

($K_2W_5O_{17}+8H_2O$ of Margueritte.)

$+8H_2O$. Extremely efflorescent. (Scheibler.)

Potassium *octo*tungstate, $K_2W_8O_{25}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27.** 49.)

Potassium tungstate, $K_8W_{10}O_{34}+9H_2O=4K_2O, 10WO_3+9H_2O$.

Properties resemble the *para*tungstate. (Gibbs, Proc. Am. Acad. **15.** 11.)

$+8H_2O=K_4W_5O_{17}+4H_2O$. Sol. in 15 pts. H_2O at 15°, but decomposed by heating into $K_2W_2O_7$ and $K_2W_3O_{10}$. (Lefort, A. ch. (5) **9.** 104.)

$K_{10}W_{14}O_{47}$. Very difficultly sol. in cold, appreciably sol. in hot H_2O, probably with decomposition. (Knorre.)

Potassium *para*tungstate, $K_{10}W_{12}O_{41}+11H_2O$ (or $K_6W_7O_{24}+6H_2O$, according to Lotz and Scheibler.)

Much more sol. in hot than cold H_2O. (Anthon.)

Sol. in 100 pts. H_2O at 16°, in 8·5 pts. at 100°. (Anthon.)

Sol. in 46·5 pts. cold, and 15·15 pts. boiling H_2O. (Riche.)

By shaking the crystals several days at 20°, 1 pt. dissolves in 71 pts. H_2O. If the salt is treated with boiling water, more goes into solution the longer it is boiled, until after several days' boiling 1 pt. of the salt is dissolved in 5·62 pts. H_2O at 18°. Kept in a closed flask, this solution contained after 26 days 1 pt. of salt to 11·9 pts. H_2O; after 153 days, 1 pt. of salt to 15·6 pts. H_2O; after 334 days, 1 pt. of salt to 15·6 pts. H_2O. Insol. in alcohol. (Marignac.)

$+8H_2O$.

Potassium sodium tungstate, $K_2WO_4, 2Na_2WO_4+14H_2O$.

Easily sol. in hot and cold H_2O. (Ullik, W. A. B. **56, 2.** 150.)

Deliquescent. Sol. in 1 pt. cold, and ½ pt. hot H_2O. (Anthon.)

Potassium sodium *para*tungstate, $Na_2O, 4K_2O, 12WO_3+15H_2O$.

Sol. in H_2O. (Marignac.)

$\frac{8}{11}Na_2O, \frac{3}{11}K_2O, 12WO_3+25H_2O$. Sol. in H_2O. (Marignac.)

Potassium tungstate tungsten oxide, K_2WO_4, W_2O_5.

Potassium tungsten bronze. (Scheibler, J. pr. **83.** 321.)

Formula is $K_2W_4O_{12}$.

Not attacked by acids, and only very sl. by alkalies. (Knorre, J. pr. (2) **27.** 49.)

$K_2WO_4, 4WO_3$. Not attacked by acids, even HF, or by alkalies+Aq. Insol. in alcohol. (Zettnow, Pogg, **130.** 262.)

Does not exist. (Knorre.)

Potassium sodium tungstate tungsten oxide, $5K_2W_4O_{12}+2Na_4W_5O_{15}$.

Potassium sodium tungsten bronze. Properties as potassium bronze.

$3K_2W_4O_{12}, 2Na_2W_3O_9$. As above. (Knorre, J. pr. (2) **27.** 49.)

Samarium *meta*tungstate, $Sm_2O_3, 12WO_3+35H_2O$.

Easily sol. in H_2O. (Cleve.)

Samarium sodium tungstate, $Na_6Sm_4(WO_4)_9$.

Insol. in H_2O. Slowly sol. in dil. acids, easily in conc. HCl+Aq. (Högbom, Bull. Soc. (2) **42.** 2.)

Argentous tungstate, $Ag_4O, 2WO_3$.

HNO_3+Aq separates WO_3. KOH+Aq dissolves out WO_3 and separates Ag_4O. (Wöhler and Rautenberg, A. **114.** 120.)

Does not exist. (Muthmann, B. **20.** 983.)

Silver tungstate, Ag_2WO_4.

Sol. in about 2000 pts. H_2O at 15°. Easily decomp. by NaCl+Aq or HNO_3+Aq. (Lefort.)

$Ag_2W_2O_7$. Insol. in H_2O. Nearly insol. in $HC_2H_3O_2$ or H_3PO_4+Aq. More sol. in KOH, NH_4OH+Aq, or $H_2C_2O_4$+Aq. (Anthon, J. pr. **9.** 347.)

$+H_2O$. Sol. in about 5000 pts. H_2O at 15°. (Lefort.)

Silver *meta*tungstate, $Ag_2W_4O_{13}+3H_2O$.

Sl. sol. in H_2O. (Scheibler, J. pr. **83.** 318.)

Silver *para*tungstate, $Ag_{10}W_{12}O_{41}+8H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

Silver tungstate ammonia, $Ag_2WO_4, 4NH_3$.

Sol. in H_2O with rapid decomp. (Widmann, Bull. Soc. (2) **20.** 64.)

Sodium tungstate, $Na_2WO_4+2H_2O$.

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Vauquelin and Hecht.)

Sol. in 1·1 pts. cold, and 0·5 pt. boiling H_2O. (Anthon.)

Sol. in 2·44 pts. H_2O at 0°; 1·81 pts. at 15°; 0·81 pt. at 100°. (Riche.)

Sp. gr. of Na_2WO_4+Aq at 24·5° containing:

5	10	15 % $Na_2WO_4+2H_2O$,
1·036	1·075	1·119
20	25	30 % $Na_2WO_4+2H_2O$,
1·166	1·215	1·274
35	40	44 % $Na_2WO_4+2H_2O$.
1·349	1·430	1·492

(Franz, J. pr. (2) **4.** 238.)

Na_2WO_4+Aq is pptd. by HCl, HNO_3, or H_2SO_4+Aq, but not by H_2SO_3, HI, HCN, oxalic, or tartaric acids + Aq, but pptn. by the former acids is not prevented by presence of the latter, but when heated with $HC_2H_3O_2+Aq$, or in presence of H_3PO_4+Aq, mineral acids cause no ppt. (Zettnow, Pogg, **130.** 16.)

Insol. in alcohol. (Riche, A. ch. (3) **50.** 52.)

Sodium *di*tungstate, $Na_2W_2O_7$.

Sol. in H_2O by heating several hours to 130-150°. (Knorre, J. pr. (2) **27.** 80.)

$+6H_2O$. Sol. in 13 pts. H_2O at 15°. (Lefort, C. R. **88.** 798.)

Sodium *tri*tungstate, $Na_2W_3O_{10}+4H_2O$.

Sol. in 1 pt. H_2O. Decomp. on standing into sol. *tetra*tungstate and insol. *di*tungstate. (Lefort, C. R. **88.** 798.)

Neither this nor the other *tri*tungstates of Lefort exist, according to Knorre (J. pr. (2) **27.** 49).

Sodium *meta*tungstate, $Na_2W_4O_{13}$.

Anhydrous. Insol. in H_2O.

$+10H_2O$.

Sol. at 13° in 0·0935 pt. H_2O to form a solution of 3·02 sp. gr. (Scheibler.)

Sol. at 19° in 0·195 pt. H_2O. (Forcher.)

Precipitated by alcohol.

Sodium *penta*tungstate, $Na_2W_5O_{16}$.

Sl. sol. in H_2O by heating 3 hours at 150°. (Knorre, J. pr. (2) **27.** 49.)

Sodium tungstate, acid, $Na_4W_3O_{11}+7H_2O$ (?).

Sol. in H_2O. (Scheibler.)

Mixture of $Na_2W_4O_{13}$ and Na_2WO_4. (Knorre, J. pr. (2) **27.** 49.)

$Na_4W_5O_{17}+11H_2O$. Efflorescent. Sol. in H_2O. (Marignac.)

100 pts. H_2O dissolve 16 pts. at 15°. (Lefort, A. ch. (5) **9.** 97.)

Formula is $4Na_2O, 10WO_3+23H_2O$, according to Gibbs (Proc. Am. Acad. **15.** 5).

Sodium *octo*tungstate, $Na_2W_8O_{25}$.

Insol. in H_2O. Very difficultly attacked by acids and alkalies. (Knorre.)

$+12H_2O$. Easily sol. in cold H_2O, and can be recryst. without decomp. (Ullik, W. A. B. **56,** **2.** 157.)

Sodium tungstate, $Na_6W_7O_{27}$ (?).

$+16H_2O$ (?). (Marignac, A. ch. (3) **69.** 51.)

$+21H_2O$ (?). Much more sol. and much more rapidly than the paratungstate. (Marignac.)

Sodium *para*tungstate, $Na_{10}W_{12}O_{41}+21H_2O$.

$+25H_2O$.

$+28H_2O=3Na_6W_7O_{24}+16H_2O$, according to Lotz and Scheibler.

Sol. in 8 pts. cold H_2O (Anthon); in 12·6 pts. at 22° (Forcher).

Sol. in about 12 pts. H_2O. (Marignac.)

The aqueous solution saturated at 35-40° contained to 1 pt. of the salt, after:

1	12	77	227	410 days,
at 18°	18°	18°	16°	20°
9·25	11·26	10·92	11·90	11·74 pts. H_2O.

The solution saturated by very long boiling, after a part of the salt had crystallised out, contained, after:

1	2	12 days,
0·68	0·91	2·59 pts. H_2O to 1 pt. salt,
72	222	405 days,
6·88	9·75	8·80 pts. H_2O to 1 pt. salt.

(Marignac.)

Decomp. by boiling with H_2O. (Knorre, B. **18.** 2362.)

Sodium strontium *para*tungstate, $Na_2O, 4SrO, 12WO_3+29H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

Sodium thorium tungstate, $Na_4Th(WO_4)_4$.

Insol. in H_2O. Slowly sol. in dil. acids, easily in conc. HCl + Aq. (Högbom, Bull. Soc. (2) **42.** 2.)

Sodium yttrium tungstate, $Na_8Y_2(WO_4)_7$.

Insol. in H_2O, and very slowly attacked by dil. acids. (Högbom, Bull. Soc. (2) **42.** 2.)

Sodium zinc *para*tungstate, $Na_2O, 2ZnO, 7WO_3+15H_2O$.

Difficultly sol. in cold, more sol. in hot H_2O. (Knorre, B. **19.** 823.)

$+21H_2O$. (Knorre.)

Sodium tungstate tungsten oxide, Na_2WO_4, W_2O_5.

Yellow tungsten bronze. Gradually deliquesces on air. Not decomp. by any acid, even aqua regia, except HF, or by alkalies. (Wöhler, Pogg. **2.** 350.)

Correct formula is $Na_5W_6O_{18}$, according to Phillip (B. **15.** 499).

Sol. in ammoniacal silver solution with separation of Ag. Easily sol. in boiling alkaline potassium ferricyanide + Aq. (Phillip, B. **12.** 2234.)

Sodium tungstate tungsten oxide, $Na_2WO_4, 2W_2O_5$.

Blue tungsten bronze. Not attacked by acids or alkalies. (Scheibler.)

Correct formula is $Na_2W_5O_{15}$, according to Phillip (B. **15.** 506).

Sol. in ammoniacal silver solution with separation of Ag.

$Na_4W_5O_{15}$. Properties as above. (Phillip, B. **15.** 499.)

$Na_2W_3O_9$. Properties as above. (Phillip.)

Strontium tungstate, $SrWO_4$.

Precipitate. (Schultze.)

Sol. in about 700 pts. H_2O. (Lefort.)

Strontium *di*tungstate, $SrW_2O_7+3H_2O$ (?).

100 ccm. H_2O dissolve 0·35 g. at 15°. (Lefort, A. ch. (5) **15**. 326.)

Strontium *tri*tungstate, $SrW_3O_{10}+5H_2O$ (?).

Sol. in H_2O with decomp. into SrW_2O_7 and SrW_4O_{13}. (Lefort, A. ch. (5) **17**. 477.)

Strontium *meta*tungstate, $SrW_4O_{13}+8H_2O$.

Solubility as calcium *meta*tungstate. (Scheibler.)

Strontium *para*tungstate, $Sr_3W_7O_{24}+16H_2O$, or $Sr_5W_{12}O_{41}+27H_2O$.

Insol. in cold, sl. sol. in hot H_2O. (Knorre, B. **18**. 327.)

Thallous tungstate, Tl_2WO_4.

Very sl. sol. in H_2O. Sol. in hot Na_2CO_3+Aq. (Flemming, J. B. **1868**. 250.)

Thallous hydrogen tungstate, $TlHWO_4$.

Insol. in H_2O. Difficultly sol. in NH_4OH+Aq. Easily sol. in boiling alkali carbonates or hydrates+Aq. (Oettinger, J. B. **1864**. 254.)

Thorium tungstate.

Precipitate. (Berzelius.)
Insol. in H_2O.

Stannous tungstate, $SnWO_4+6H_2O$.

Insol. in H_2O. Sol. in oxalic acid and in KOH+Aq. Slowly sol. in hot H_3PO_4+Aq. (Anthon, J. pr. **9**. 341.)

Stannic tungstate, $9SnO_2$, $13WO_3$.

Insol. in ammonium tungstate+Aq. Sol. in tin salts+Aq, also in phosphoric, oxalic, or tartaric acids+Aq. (Lotz, A. **91**. 49.)

Tungsten tungstate, WO_2, $WO_3=W_2O_5$.

See **Tungsten oxide**, W_2O_5.

Uranous tungstate, UO_2, $3WO_3+6H_2O$.

Decomp. by NaOH+Aq or HNO_3+Aq. Sol. in HCl+Aq, but not in H_2SO_4. (Rammelsberg.)

Uranyl tungstate, UO_3, WO_3+2H_2O.

Sol. in about 100 pts. H_2O. (Lefort, C. R. **87**. 748.)
UO_3, $3WO_3+5H_2O$ (?). Sol. in about 200 pts. H_2O. (Lefort.)

Vanadium tungstate.

Sl. sol. in H_2O.

Yttrium tungstate, $Y_2(WO_4)_3+6H_2O$.

Very sl. sol. in H_2O, but more sol. in Na_2WO_4+Aq. (Berlin.)

Zinc tungstate, $ZnWO_4$.

Insol. in H_2O. (Geuther and Forsberg, A. **120**. 270.)
$+H_2O$. Sol. in 500 pts. H_2O.

Zinc *di*tungstate, $ZnW_2O_7+3H_2O$ (?).

Sol. in 10 pts. H_2O at 15°, but solution soon decomposes. (Lefort.)

Zinc *tri*tungstate, $ZnW_3O_{10}+5H_2O$.

Insol. in boiling H_2O. Sol. in $ZnSO_4$+Aq, or $Na_4W_5O_{17}$+Aq. (Gibbs.)

Zinc *meta*tungstate, $ZnW_4O_{13}+10H_2O$.

Easily sol. in H_2O. Loses crystal H_2O by ignition, and becomes insol. in H_2O. (Scheibler, J. pr. **83**. 273.)

Zinc tungstate, $Zn_4W_{10}O_{34}+18H_2O=4ZnO$, $10WO_3+18H_2O$.

Insol. in H_2O. Sol. in excess of zinc sulphate or of sodic tungstate+Aq. (Gibbs, Proc. Am. Acad. **15**. 14.)
$+29H_2O$. (Gibbs.)

Zinc *para*tungstate, $5ZnO$, $12WO_3+37H_2O$.

(Gonzalez, J. pr. (2) **36**. 44.)

Zinc tungstate, $Zn_9W_{22}O_{75}+66H_2O=9ZnO$, $22WO_3+66H_2O$.

Insol. in H_2O. (Gibbs.)

Tungstoboric acid.

See **Borononotungstic acid.**

Tungstoiodic acid.

Potassium tungstoiodate, $K_2H_3WIO_8$.

(Blomstrand, J. pr. (2) **40**. 327.)

Tungstosilicic acid, $H_8W_{12}SiO_{42}+20H_2O$.

Stable or deliquescent, according to the amount of moisture in the air. Melts partly in crystal water below 100°. Very sol. in alcohol or ether. (Marignac, A. ch. (4) **3**. 10.)
See also **Silicotungstic acid.**

Aluminum tungstosilicate, $Al_4H_{12}(W_{12}SiO_{42})_3+75H_2O$.

Not deliquescent. Sol. in H_2O.

Barium ——, $Ba_4W_{12}SiO_{42}$.

$+9H_2O$, and $27H_2O$. Nearly insol. in cold, sl. sol. in hot H_2O, separating therefrom on cooling. (Marignac.)

Calcium ——, $Ca_5H_6(W_{12}SiO_{42})_2+47H_2O$.

Less easily moist than the following salt.
$Ca_2H_4W_{12}SiO_{42}+20H_2O$. Not deliquescent, but becomes moist easily. Extremely easily sol. in H_2O. (Marignac.)

Potassium ——, $K_8W_{12}SiO_{42}+20H_2O$.

Much less sol. in cold than hot H_2O. Extremely sol. in hot H_2O. More sol. than silicotungstate.
$K_4H_4W_{12}SiO_{42}+7H_2O$. Solubility as preceding salt. (Marignac.)

Sodium ——, $Na_4H_4W_{12}SiO_{42}+10H_2O$.

Stable on air. Extremely sol. in H_2O. (Marignac.)

Tungstous acid.

Sodium tungstite, $Na_2W_2O_5$.

See **Tungstate tungsten oxide, sodium.**

Tungstovanadic acid.

See **Vanadiotungstic acid.**

Tungstyl *di*bromide, WO_2Br_2.

Not decomp. by cold H_2O. (Roscoe.)

Tungstyl *tetra*bromide, $WOBr_4$.

Extremely deliquescent. Decomposes at once in moist air or with H_2O.

Tungstyl *di*chloride, WO_2Cl_2.

Not decomp. by cold, and but slowly by boiling H_2O. Sol. in alkalies and ammonia.

Tungstyl *tetra*chloride, $WOCl_4$.

Easily decomp. by H_2O or moist air.

Ultramarine blue, $2Na_2Al_2Si_2O_8$, Na_2S_2 (?).

Not attacked by solutions of alkalies or NH_4OH + Aq. Decomp. by acids or acid salts + Aq. Decomp. by alum + Aq.

Ultramarine green, $Na_2Al_2Si_2O_8$, Na_2S (?).

Decomp. by mineral acids. Not attacked by alkalies. Decomp. by alum + Aq.

Ultramarine white, $2Na_2Al_2Si_2O_8$, Na_2S (?).

Uranic acid, H_2UO_4.

Insol. in H_2O. Sol. in acids. Very sol. in cold dil. HNO_3 + Aq. Sl. sol. in boiling NH_4Cl + Aq. Insol. in KOH, NaOH, or NH_4OH + Aq. Easily sol. in $(NH_4)_2CO_3$, $KHCO_3$, and $NaHCO_3$ + Aq; less in K_2CO_3 + Aq. (Ebelmen.)

H_4UO_5. Insol. in H_2O; sol. in acids. (Ebelmen.)

Uranates.

Insol. in H_2O; sol. in acids.

Ammonium uranate.

Sl. sol. in pure H_2O; insol. in H_2O containing NH_4Cl or NH_4OH.

Sol. in $(NH_4)_2CO_3$ + Aq. (Peligot, A. ch. (3) **5.** 11.)

Barium uranate, $BaUO_4$.

Insol. in H_2O. Sol. in dil. acids.

BaU_2O_7. As above. (Ditte, C. R. **95.** 988.)

Bismuth uranate, Bi_2O_3, $UO_3 + H_2O$.

Min. *Uranosphærite.*

Calcium uranate, $CaUO_4$.

Insol. in H_2O; sol. in dil. acids. (Ditte, C. R. **95.** 988.)

CaU_2O_7. Insol. in H_2O; sol. in dil. acids. (Ditte.)

Cobalt uranate.

Insol. in H_2O; sol. in $Pb(C_2H_3O_2)_2$ + Aq. (Persoz, J. pr. **3.** 216.)

Sol. in HNO_3 + Aq; insol. in KNO_3 + Aq. (Ebelmen, A. ch. (3) **5.** 222.)

Cupric uranate, CuU_2O_7.

Insol. in H_2O. (Debray, A. ch. (3) **61.** 451.)

Lead uranate, $PbUO_4$.

If ignited, very difficultly sol. in $HC_2H_3O_2$ + Aq. (Wertheim, J. pr. **29.** 228.)

Insol. in $Pb(C_2H_3O_2)_2$ + Aq. (Persoz.)

3PbO, $2UO_3$. Sol. in dil. HNO_3 + Aq. (Ditte, A. ch. (6) **1.** 338.)

Lithium uranate, Li_2UO_4.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids.

Magnesium uranate, $MgUO_4$.

Insol. in H_2O. Nearly insol. in cold HCl + Aq. Slowly sol. in HCl + Aq on warming, and more rapidly by addition of a little HNO_3 + Aq. (Ditte.)

MgU_2O_7. Ppt. (Berzelius.)

Potassium uranate, K_2UO_4 (?).

Insol. in H_2O; sol. in dil. acids, etc., exactly as Na_2UO_4. (Ditte.)

$K_2U_2O_7 + 6H_2O$. Insol. in H_2O. Sol. in dil. acids, even acetic acid. (Zimmermann, B. **14.** 440.)

Insol. in K_2CO_3 + Aq, but easily sol. in alkali hydrogen carbonates + Aq. Sol. in HCl + Aq. (Ebelmen, A. ch. (3) **5.** 220.)

K_2O, $6UO_3 + 6H_2O$. Insol. in H_2O. (Drenckmann, Zeit. ges. Nat. **17.** 113.)

Rubidium uranate, $RbUO_4$.

Insol. in H_2O. (Ditte, A. ch. (6) **1.** 338.)

Silver uranate, $Ag_2U_2O_7$.

Insol. in H_2O. Easily sol. in acids. (Alibegoff, A. **233.** 117.)

Sodium uranate, Na_2UO_4 (?).

Insol. in H_2O; sol. in dil. acids. Sol. in alkali carbonates + Aq. (Ditte.)

$Na_2U_2O_7 + 6H_2O$. Insol. in H_2O. Sol. in dil. acids. (Stolba, Z. anal. **3.** 74.)

Na_2O, $3UO_3$. Insol. in H_2O. Easily sol. in very dil. acids. (Drenckmann.)

Strontium uranate, $SrUO_4$.

Insol. in H_2O. Sol. in dil. acids.

SrU_2O_7. As above. (Ditte, C. R. **95.** 988.)

Thallous uranate.

Ppt. (Bolton, Am. Chemist. **1872, 2.** 456.)

Zinc uranate.

Insol. in H_2O; sol. in $Pb(C_2H_3O_2)_2$ + Aq. (Persoz, J. pr. **3.** 216.) Sol. in HNO_3 + Aq; insol. in KNO_3, and NH_4NO_3 + Aq. (Ebelmen, A. ch. (3) **5.** 221.)

*Per*uranic acid.

See **Peruranic acid.**

Uranium, U.

Not attacked by H_2O. Slowly decomp. by cold dil. H_2SO_4 + Aq, rapidly on warming. Easily sol. in dil. or conc. HCl + Aq. Fused U is slightly attacked by conc. or fuming HNO_3, or conc. H_2SO_4. Amorphous U, however, is easily attacked thereby. Not attacked by acetic acid, KOH, NaOH, or NH_4OH + Aq. (Zimmermann, B. **15.** 849.)

Uranium *tri*bromide, UBr_3.

Very hygroscopic. Sol. in H_2O with hissing. (Alibegoff, A. **233.** 117.)

Uranium *tetra*bromide, UBr_4.

Anhydrous. Very deliquescent. Sol. in H_2O with hissing. (Hermann.)

$+ 8H_2O$. Very deliquescent, and sol. in H_2O. (Rammelsberg.)

Uranium *tri*chloride, UCl_3.

Very sol. in H_2O. (Peligot.)

Very unstable. (Zimmermann.)

Uranium *tetra*chloride, UCl_4.

Anhydrous. Extremely deliquescent.

Sol. in H_2O with evolution of heat. Decomp. on boiling. Sol. in NH_4Cl+Aq without decomp.

Uranium *penta*chloride, UCl_5.

Deliquescent. Sol. in H_2O with evolution of heat and decomposition. (Roscoe, B. **7.** 1131.)

Uranium *tetra*fluoride, UF_4.

Insol. in H_2O. Very sl. sol. in dil. acids. Sol. in hot conc. H_2SO_4, and slowly in warm conc. HNO_3+Aq. (Bolton, J. B. **1866.** 209.)

Uranium *hexa*fluoride, UF_6 (?).

Very sol. in H_2O. (Ditte, A. ch. (6) **1.** 339.)

Is UO_2F_2. (Smithells, Chem. Soc. **43.** 131.)

Uranium hydrogen fluoride, UF_6, 8HF (?).

Sol. in H_2O. (Ditte.)

Is UO_2F_2, $HF+H_2O$. (Smithells.)

Uranous hydroxide, UO_2, xH_2O.

Easily sol. in dil. acids.

Insol. in alkali hydrates and carbonates $+Aq$. (Berzelius.)

Sol. in alkali carbonates $+Aq$. (Rammelsberg.)

Uranouranic hydroxide, U_3O_8, $6H_2O$ (?).

Easily sol. in acids.

Decomp. by $(NH_4)_2CO_3+Aq$, which dissolves out UO_3. (Berzelius.)

Uranic hydroxide.

See **Uranic acid.**

Uranium *sub*oxide, UO (?).

(Guyard, Bull. Soc. (2) **1.** 89.)

Does not exist. (Zimmermann, A. **213.** 301.)

U_2O_3 (?). Ppt. Decomp. by H_2O and in the air. (Peligot.)

Uranium *di*oxide (Uranous oxide), UO_2.

Insol. in dil. HCl or H_2SO_4+Aq.

Sol. in conc. H_2SO_4, and easily in HNO_3+Aq. (Peligot.)

Insol. in NH_4Cl+Aq. (Rose.)

Uranium *tetr*oxide, UO_4.

Decomp. by $HCl+Aq$. (Fairley, Chem. Soc. **31.** 133.)

$+2H_2O$. Very hygroscopic. (Zimmermann.)

$+3H_2O$.

Uranium *pent*oxide, U_2O_5.

Sol. in acids. (Peligot.)

Mixture of UO_3 and U_3O_8. (Rammelsberg, Pogg. **59.** 5.)

Mixture of UO_2 and U_3O_8. (Zimmermann, A. **232.** 273.)

Uranouranic oxide, U_3O_8.

Green uranium oxide. Very slowly and slightly sol. in dil. HCl or H_2SO_4+Aq; more easily when conc. Completely sol. in boiling H_2SO_4. Easily sol. in HNO_3+Aq.

Min. *Uraninite* (*Uranpecherz*). Easily sol. in warm HNO_3+Aq. Not attacked by $HCl+Aq$.

Uranium *tri*oxide (Uranic oxide), UO_3.

Sol. in HNO_3+Aq. (Peligot.)

See **Uranic acid.**

Uranic oxy- compounds.

See **Uranyl compounds.**

Uranous oxysulphide, $U_3O_2S_4=UO_2$, $2US_2$.

Slightly attacked by dil., easily by conc. $HCl+Aq$. Sol. in cold HNO_3+Aq. (Hermann, J. B. **1861.** 258.)

Uranium *mono*sulphide, US.

(Alibegoff, A. **233.** 117.)

Uranium *sesqui*sulphide, U_2S_3.

Not attacked by HCl or dil. HNO_3+Aq. Oxidised by fuming H_2SO_4 or aqua regia. (Alibegoff, A. **233.** 117.)

Uranium *di*sulphide, US_2.

Insol. in cold or boiling dil. $HCl+Aq$. Sol. in cold conc. $HCl+Aq$. Decomp. by HNO_3+Aq. (Hermann, J. B. **1861.** 258.)

Uranyl bromide, $UO_2Br_2+7H_2O$.

Deliquescent. Sol. in H_2O.

Uranyl chloride, UO_2Cl_2.

Anhydrous. Very deliquescent. Sol. in H_2O, alcohol, and ether.

$+H_2O$. Sol. in H_2O, alcohol, and ether.

Uranyl *di*amine chloride, $UO_2(NH_3Cl)_2$.

Decomp. by H_2O. (Regelsberger, A. **227.** 119.)

Uranyl *tri*amine chloride,
$UO_2(NH_3 . NH_3Cl)NH_3Cl$.

Decomp. by H_2O. (Regelsberger, A. **227.** 119.)

Uranyl *tetr*amine chloride, $UO_2(NH_3 . NH_3Cl)_2$.

Decomp. by H_2O. (Regelsberger, A. **227.** 119.)

Uranyl fluoride, UO_2F_2.

Very sol. in H_2O. (Smithells, Chem. Soc. **43.** 125.)

Insol. in H_2O or dil. acids. Very sl. sol. in $HF+Aq$. Sol. in H_2SO_4 +aqua regia. (Ditte, A. ch. (6) **1.** 339.)

This compound is UF_4. (Smithells.)

UOF_4. Very sol. in H_2O. (Ditte, C. R. **91.** 115.)

True composition is UO_2F_2. (Smithells.)

Uranyl hydrogen fluoride, UO_2F_2, $HF+H_2O$.

Very sol. in H_2O. (Smithells, Chem. Soc. **43.** 131.)

Uranyl sulphide, UO_2S.

Sl. sol. in pure H_2O. Sol. in dil., insol. in absolute alcohol. Sol. in conc. $HCl+Aq$, also in dil. acids. Decomp. by caustic alkalies $+Aq$. Partly sol. in $(NH_4)_2S+Aq$.

***Meta*vanadic acid,** HVO_3.

Insol. in H_2O; sol. in acids and alkalies.

$+\frac{1}{2}H_2O$.

See **Vanadium *pent*oxide.**

***Pyro*vanadic acid,** $H_4V_2O_7$.

Insol. in H_2O. Sol. in acids and alkalies.

Vanadates.

The alkali, Ba, and Pb metavanadates are sl. sol. in H_2O, the others are more easily sol. Insol. in alcohol.

Aluminum *meta*vanadate.

Very sl. sol. in H_2O. (Berzelius.)

Aluminum *di*vanadate.

Very sl. sol. in H_2O. (Berzelius.)

Ammonium *meta*vanadate, $(NH_4)VO_3$.

(*a*) Very slowly and sparingly sol. in cold H_2O. Easily sol. in hot H_2O. (Berzelius.)

Easily sol. in H_2O at about 70°. Very sl. sol. at above and below that temperature. (Guyard, Bull. Soc. (2) **25**. 355.)

10 g. dissolve in 1 litre cold, and 63 g. in 1 litre hot H_2O with partial decomp. (Ditte, C. R. **102**. 918.)

Extremely sl. sol. in sat. NH_4Cl+Aq. (v. Hauer.)

Insol. in sat. NH_4Cl+Aq.

Insol. in alcohol. (v. Hauer.)

(*b*) Sol. in cold H_2O, from which it is pptd. by alcohol. (Berzelius.)

Ammonium *di*vanadate, $(NH_4)_2V_4O_{11}+4H_2O$.

Sol. in H_2O, from which it is precipitated by sat. NH_4Cl+Aq or alcohol. (v. Hauer, W. A. B. **21**. 337.)

Correct formula is $(NH_4)_3V_7O_{10}+2H_2O$, according to Rammelsberg (B. A. B. **1883**. 3).

$+3H_2O$. Very sol. in H_2O. (Ditte, C. R. **102**. 918.)

Ammonium *tri*vanadate, $(NH_4)_2V_6O_{16}$.

Anhydrous. Nearly insol. in hot or cold H_2O. (Norblad, B. **8**. 126.)

1·5 g. dissolve in 1 litre of boiling H_2O. (Ditte, C. R. **102**. 918.)

$+5H_2O$. Very sl. sol. in H_2O. (Ditte.)

$+6H_2O$ (?). Very sol. in H_2O. (v. Hauer, W. A. B. **39**. 455.)

Could not be obtained. (Norblad; also Rammelsberg, B. A. B. **1883**. 3.)

Ammonium vanadate, $(NH_4)_3V_7O_{10}+2H_2O$.

Correct formula of v. Hauer's *di*vanadate, according to Rammelsberg (B. A. B. **1883**. 3).

Sl. sol. in H_2O.

Ammonium *sesqui*vanadate, $(NH_4)_4V_6O_{17}+4$ or $6H_2O$.

Very sol. in H_2O. (Ditte, C. R. **102**. 918.)

Ammonium *penta*vanadate, $(NH_4)_4V_{10}O_{27}+10H_2O$.

Sol. in H_2O. (Rammelsberg, B. A. B. **1883**. 3.)

Ammonium potassium vanadate, $K_2V_4O_{11}, (NH_4)_4V_6O_{17}+9H_2O$.

Sol. in H_2O. (Ditte, C. R. **104**. 1844.)

Ammonium sodium vanadate, $Na_2V_4O_{11}, (NH_4)_4V_6O_{17}+15H_2O$.

Sol. in H_2O. (Ditte, C. R. **104**. 1841.)

Ammonium uranyl vanadate, $(NH_4)_2O, 2UO_3, V_2O_5+H_2O$.

Insol. in H_2O, NH_4OH+Aq, or dil. $HC_2H_3O_2+Aq$. (Carnot, C. R. **104**. 1850.)

Barium *meta*vanadate, $Ba(VO_3)_2+H_2O$.

Somewhat sol. in H_2O before ignition. Sol. in conc. H_2SO_4. (Berzelius.)

Barium *pyro*vanadate, $Ba_2V_2O_7$.

Somewhat sol. in H_2O. (Roscoe.)

Barium vanadate, $Ba_2V_6O_{17}+14H_2O$.

(Ditte, C. R. **104**. 1705.)

$Ba_3V_{10}O_{28}+19H_2O$. 1 pt. is sol. in 5200 pts. H_2O at 20-25°. Much more sol. in hot, but decomp. by boiling H_2O. (v. Hauer, W. A. B. **21**. 344.)

Sol. in about 5000 pts. H_2O. (Manasse, C. C. **1886**. 773.)

$Ba_4V_{10}O_{29}+2H_2O$. (Norblad.)

Bismuth vanadate, $Bi_2(VO_4)_2$.

Min. *Pucherite.* Sol. in $HCl+Aq$ with evolution of Cl.

Cadmium vanadate, $Cd(VO_3)_2$.

(Ditte, C. R. **102**. 918.)

$CdV_6O_{16}+24H_2O$. Sl. sol. in H_2O. (Ditte, C. R. **104**. 1705.)

Cadmium potassium vanadate, $CdK_2V_6O_{17}+9H_2O$.

(Radau, A. **251**. 148.)

$Cd_3V_{10}O_{28}, K_6V_{10}O_{28}+27H_2O$. 1000 pts. H_2O dissolve 5·4 pts. at 18°. (Radau.)

Calcium *meta*vanadate, $Ca(VO_3)_2+4H_2O$.

Much more sol. than $Sr(VO_3)_2$, and solution is not precipitated by alcohol. (Berzelius.)

Calcium *pyro*vanadate, $Ca_2V_2O_7+5H_2O$.

Precipitate.

$+2H_2O$. Very sol. in dil. acids. (Ditte C. R. **104**. 1705.)

$+2\frac{1}{2}H_2O$. (Roscoe.)

Calcium *di*vanadate, $CaV_4O_{11}+9H_2O$.

Easily sol. in H_2O. (v. Hauer.)

When fused is nearly insol. in H_2O. (v. Hauer.)

$+6H_2O$. (Manasse, A. **240**. 23.)

Calcium *tri*vanadate, $CaV_6O_{17}+12H_2O$.

Very sol. in H_2O. (Ditte, C. R. **104**. 1705.)

Calcium vanadate, $Ca_3V_8O_{23}+15H_2O$.

Sol. in H_2O. (Manasse, A. **240**. 23.)

$Ca_3V_{14}O_{38}+7H_2O$ (?). Sl. sol. in H_2O. Probably a mixture. (Manasse, A. **240**. 23.)

$Ca_3V_{16}O_{43}+26H_2O$. Sol. in H_2O. (Manasse, A. **240**. 23.)

Calcium copper vanadate, $(Ca,Cu)_4V_2O_9+H_2O$.

Min. *Volborthite.* Sol. in HNO_3+Aq.

Calcium potassium vanadate, $CaK_8V_{20}O_{55}+22H_2O$.

Sol. in H_2O. (Manasse, A. **240**. 23.)

Calcium vanadate chloride, $Ca_3(VO_4)_2$, $CaCl_2$.
(Hautefeuille, C. R. **77.** 896.)

Chromium vanadate, $CrVO_4$.

Absolutely insol. in H_2O containing $NH_4C_2H_3O_2$ and $HC_2H_3O_2$. (Carnot, C. R. **104.** 1850.)

Cobaltous *meta*vanadate, $Co(VO_3)_2+3H_2O$.

Easily sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Cobaltous potassium vanadate, $CoKV_5O_{14}+8H_2O$.

1000 pts. H_2O dissolve 4·8 pts. of this salt. (Radau, A. **251.** 140.)

$Co_3K_2V_{14}O_{39}+21H_2O$. (Radau.)

Cupric *meta*vanadate.

Sol. in H_2O. (Berzelius.)

Cupric *pyro*vanadate, $Cu_2V_2O_7+3H_2O$.

Sol. in hot H_2O. (Ditte, C. R. **104.** 1705.)

Could not be obtained. (Radau, A. **251.** 150.)

Cupric lead vanadate, $5(Cu,Pb)O$, $V_2O_5+2H_2O$.

Min. *Mottramite.*

$3CuO$, V_2O_5, $3(3PbO$, $V_2O_5)$, $6CuO_2H_2+12H_2O$. Min. *Psittacinnite.*

Cupric potassium vanadate, $CuKV_9O_{24}+17H_2O$.

Moderately sol. in warm H_2O. 100 pts. H_2O dissolve 11·1 pts. at 18°. (Radau, A. **251.** 151.)

Didymium vanadate, $Di_2(VO_4)_2$.

Precipitate. (Cleve.)

$Di_2V_{10}O_{30}+28H_2O$. Precipitate. (Cleve, Bull. Soc. (2) **43.** 365.)

Glucinum *meta*vanadate (?).

Difficultly sol. in H_2O. (Berzelius.)

Glucinum *di*vanadate (?).

Difficultly sol. in H_2O. (Berzelius.)

Ferrous *meta*vanadate.

Ppt. Sol. in $HCl+Aq$. (Berzelius.)

Ferric *meta*vanadate.

Somewhat sol. in H_2O. (Berzelius.)

Lead *meta*vanadate, $Pb(VO_3)_2$.

Sl. sol. in H_2O. Easily sol. in warm dil. HNO_3+Aq. Not completely decomp. by H_2SO_4 or by boiling with K_2CO_3+Aq. (Berzelius.)

Min. *Dechenite.* Easily sol. in dil. HNO_3+Aq, and decomp. by $HCl+Aq$.

Lead *pyro*vanadate, basic, $2Pb_2V_2O_7$, PbO.

Insol. in boiling H_2O or $HC_2H_3O_2$. Decomp. by HNO_3+Aq with separation of V_2O_5, which dissolves on warming. (Roscoe.)

Lead *pyro*vanadate, $Pb_2V_2O_7$.

Sol. in warm dil. HNO_3+Aq. (Ditte, C. R. **104.** 1705.)

Min. *Descloizite.* Sol. in cold dil. HNO_3+Aq.

Lead *di*vanadate, PbV_4O_{11}.
(Ditte, C. R. **104.** 1705.)

Lead *ortho*vanadate, $Pb_3(VO_4)_2$.

Insol. in H_2O. (Roscoe, A. suppl. **8.** 109.)

Lead zinc *ortho*vanadate, $4Pb_3(VO_4)_2$, $3Zn_3(VO_4)_2$.

Min. *Eusynchite.* Easily sol. in HNO_3+Aq.

Lead zinc vanadate, $(Pb, Zn)_4V_2O_9+H_2O$.

Min. *Descloizite.* Sol. in excess of HNO_3+Aq.

Lead vanadate chloride, $3Pb_3(VO_4)_2$, $PbCl_2$.

Min. *Vanadinite.* Easily sol. in HNO_3+Aq.

Lithium *meta*vanadate, $LiVO_3$.

Easily sol. in H_2O. (Berzelius.)

$+2H_2O$. Quite easily sol. in H_2O. (Rammelsberg, B. A. B. **1883.** 3.)

Lithium *di*vanadate, $Li_2V_4O_{11}+9H_2O$.

Very sol. in H_2O. (Norblad.)

Correct formula is $Li_3V_5O_{14}+12H_2O$. (Rammelsberg.)

$+8$ or $12H_2O$. (Ditte, C. R. **104.** 1168.)

Lithium *ortho*vanadate, Li_3VO_4.

Insol. in H_2O. (Rammelsberg, B. A. B. **1883.** 3.)

Lithium *pyro*vanadate, $Li_4V_2O_7+4H_2O$.

Very sol. in H_2O. (Rammelsberg, B. **16.** 1676.)

$+3H_2O$. (Ditte, C. R. **104.** 1168.)

Lithium vanadate, basic, $Li_6V_2O_8+6H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 1168.)

$Li_8V_2O_9+H_2O$, and $14H_2O$. Sol. in H_2O. (Ditte.)

Lithium vanadate, $Li_3V_5O_{14}+7H_2O$.

Difficultly sol. in H_2O. (Rammelsberg.)

$+12H_2O$. Very efflorescent. Correct formula for v. Hauer's *di*vanadate. (Rammelsberg.)

$Li_4V_6O_{17}+16H_2O$. Sol. in H_2O. (Ditte, C. R. **104.** 1168.)

$+15H_2O$. (Rammelsberg.)

$+11H_2O$. (R.)

$+3H_2O$. (R.)

$Li_6V_4O_{13}+15H_2O$. Not very easily sol. in H_2O. (Rammelsberg.)

$Li_6V_8O_{23}+12H_2O$. Moderately sol. in H_2O. (Rammelsberg.)

$Li_{10}V_{12}O_{35}+30H_2O$. Efflorescent. Very sol. in H_2O. (Rammelsberg.)

Magnesium *meta*vanadate, $Mg(VO_3)_2$.

Very easily sol. in H_2O. (Berzelius.)

$+6H_2O$. Very sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Magnesium *di*vanadate, $MgV_4O_{11}+8H_2O$.

Difficultly sol. in H_2O, but much more sol. than barium *di*vanadate. (v. Hauer.)

$+9H_2O$. (Ditte, C. R. **104.** 1705.)

Magnesium *tri*vanadate, $Mg_2V_6O_{17}+4\frac{1}{2}H_2O$.

Very sl. sol. in H_2O. (Manasse, A. **240.** 23.)

Magnesium vanadate, $Mg_3V_{10}O_{28}+28H_2O$.
Sol. in H_2O. (Suguira and Baker, Chem. Soc. **35**. 715.)

Manganous *meta*vanadate, $Mn(VO_3)_2+4H_2O$.
Very sl. sol. in cold, somewhat more sol. in hot H_2O. Easily sol. in dil. acids. (Radau, A. **251**. 125.)

Manganous *pyro*vanadate, $Mn_2V_2O_7$.
Sl. sol. in hot dil. HNO_3+Aq. (Ditte, C. R. **96**. 1048.)

Manganous potassium vanadate, $MnKV_5O_{14}+8H_3O$.
100 pts. H_2O dissolve 1·7 pts. salt at 18°. Easily sol. in acids. (Radau, A. **251**. 129.)
$3Mn_3V_8O_{23}$, $K_6V_8O_{23}+54H_2O$. (Radau.)
$7Mn(VO_3)_2$, $2KVO_3+25H_2O$. (Radau.)
$11Mn(VO_3)_2$, $2KVO_3+48H_2O$. (Radau.)

Mercuric vanadate.
Sl. sol. in H_2O.

Nickel vanadate, $Ni(VO_3)_2$.
Sol. in H_2O. (Ditte, C. R. **104**. 1705.)

Nickel *ortho*vanadate, $Ni_3(VO_4)_2$.
Insol. in H_2O; sol. in HNO_3+Aq. (Ditte, C. R. **96**. 1049.)

Nickel *di*vanadate, $NiV_4O_{11}+3H_2O$.
Sol. in H_2O. (Ditte, C. R. **104**. 1705.)

Nickel potassium vanadate, $5Ni(VO_3)_2$, $2KVO_3+25H_2O$.
$Ni_3K_2V_{10}O_{29}+17H_2O$. Very sl. sol. in hot H_2O.
$NiKV_5O_4+8H_2O$.
$2Ni_4V_{14}O_{39}$, $K_8V_{14}O_{39}+69H_2O$. 1000 pts. H_2O dissolve 1·7 pts. of salt at 17·5°. (Radau, A. **251**. 137.)

Potassium *meta*vanadate, KVO_3.
Anhydrous. Slowly sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Berzelius.)
Completely sol. in a little cold H_2O. (Norblad.)
$+H_2O$. Sol. in H_2O. (Rammelsberg.)
$+1\frac{1}{4}H_2O$.
$+1\frac{1}{2}H_2O$.
$+2H_2O$.
$+3H_2O$. (Ditte, C. R. **104**. 902.)
$+7H_2O$. (Rammelsberg.)

Potassium *di*vanadate, $K_2V_4O_{11}+4H_2O$.
Sol. in cold or lukewarm H_2O. Decomp. by hot H_2O. (Rammelsberg.)
$+3H_2O$. (Berzelius.)
$+3\frac{1}{2}H_2O$. Sol. in warm H_2O. (Norblad.)
+8 or $10H_2O$. (Ditte, C. R. **104**. 902.)

Potassium *tri*vanadate, $K_2V_6O_{16}$.
Anhydrous. Nearly insol. in H_2O. (Norblad.)
$+6H_2O$. Insol. in cold or hot H_2O. (Norblad.)
+1, and $5H_2O$. (Ditte, C. R. **104**. 902.)

Potassium *ortho*vanadate, $K_3VO_4+4\frac{1}{2}$ or $6H_2O$.
Deliquescent. Sol. in H_2O. (Ditte, C. R. **104**. 902.)
Decomp. by H_2O into $K_4V_2O_7$ and KOH. (Rammelsberg, B. A. B. **1883**. 3.)

Potassium *pyro*vanadate, $K_4V_2O_7+3H_2O$.
Deliquescent. Easily sol. in H_2O. Insol. in alcohol. (Norblad.)
$+4H_2O$. (Ditte, C. R. **104**. 902.)

Potassium vanadate, $K_3V_5O_{14}+5H_2O$.
100 pts. H_2O dissolve 19·2 pts. at 17·5°. (Radau, A. **251**. 120.)
$+4\frac{1}{2}H_2O$. (Radau.)
$K_4V_6O_{17}+2H_2O$. Slowly sol. in H_2O. (Rammelsberg.)
$+6H_2O$. (Ditte, C. R. **104**. 902.)
$+7H_2O$. (Friedheim, B. **23**. 1526.)
$K_4V_{10}O_{27}+12H_2O$. Very sol. in H_2O. (Manasse, A. **240**. 42.)
$K_{10}V_8O_{25}+7H_2O$. Sol. in H_2O. (Rammelsberg.)

Potassium vanadate, basic, $K_8V_2O_9+20H_2O$.
Sol. in H_2O. (Ditte, C. R. **104**. 902.)

Potassium strontium vanadate, $K_2Sr_3V_{14}O_{39}+20H_2O$.
Sol. in H_2O. (Manasse, A. **240**. 23.)
$K_2Sr_3V_{14}O_{39}+30H_2O$. As above. (Manasse.)
$K_4Sr_2V_{14}O_{39}+18H_2O$. As above. (Manasse.)

Potassium zinc vanadate, $KZnV_5O_{14}+8H_2O$.
1000 pts. H_2O dissolve 4·1 pts. of the salt. (Radau, A. **251**. 145.)
$2K_8V_{14}O_{39}$, $3Zn_4V_{14}O_{39}+90H_2O$. (Radau.)

Samarium vanadate, Sm_2O_3, $5V_2O_5+28H_2O$.
(Cleve.)
$+24H_2O$. (Cleve.)

Samarium *ortho*vanadate.
Precipitate.

Silver *meta*vanadate, $AgVO_3$.
Sol. in HNO_3 or dil. NH_4OH+Aq. (Berzelius.)

Silver *ortho*vanadate, Ag_3VO_4.
Ppt. Easily sol. in HNO_3 or NH_4OH+Aq. (Roscoe, Proc. Roy. Soc. **18**. 316.)

Silver *pyro*vanadate, $Ag_4V_2O_7$.
Ppt. (Roscoe.)
Sol. in NH_4OH+Aq. (Ditte, C. R. **104**. 1705.)

Silver vanadate, $Ag_6V_4O_{13}$.
Sol. in 21,414 pts. H_2O at 14°, and 13,617 pts. at 100°. (Carnelley, A. **166**. 155.)

Silver vanadate ammonia, $6AgVO_3$, $4NH_3+2H_2O$.
(Ditte, C. R. **104**. 1705.)

Sodium *meta*vanadate, $NaVO_3$.
Anhydrous. Slowly sol. in cold, very easily in hot H_2O. (Norblad.)
$+2H_2O$. Easily sol. in H_2O.
$+\frac{1}{2}H_2O$. (Ditte, C. R. **104**. 1061.)
+3, 4, and $5H_2O$. (Ditte.)

Sodium *di*vanadate, $Na_2V_4O_{11}$.
Anhydrous. Sl. sol. even in warm H_2O, but easily sol. on addition of acids.

$+9H_2O$. Easily sol. in cold H_2O. Insol. in alcohol. (Norblad.)
$+5H_2O$. (Ditte, C. R. **104.** 1061.)
Not obtained by Rammelsberg (B. A. B. **1883.** 3.)

Sodium *tri*vanadate, $Na_2V_6O_{16}+9H_2O$.
Insol. in cold or hot H_2O. (Norblad.)
Composition is $Na_6V_{16}O_{43}+24H_2O$. (Rammelsberg.)
$+3H_2O$. (Ditte, C. R. **104.** 1061.)

Sodium *ortho*vanadate, $Na_3VO_4+16H_2O$.
Easily sol. in H_2O, but decomp. into $Na_4V_2O_7$ and KOH. Precipitated by an excess of alcohol. (Roscoe, A. suppl. **8.** 102.)
$+7H_2O$. (Hall, Chem. Soc. **51.** 96.)
$+10$, and $12H_2O$. Less sol. in dil. NaOH+Aq than in H_2O. (Baker, A. **229.** 286.)

Sodium *pyro*vanadate, $Na_4V_2O_7+18H_2O$.
Easily sol. in H_2O. Insol. in alcohol. (Norblad.)
Sol. in alcohol. (Ditte, C. R. **104.** 1061.)
$+8H_2O$. (Ditte.)

Sodium *sesqui*vanadate, $Na_4V_6O_{17}$.
Anhydrous. Insol. in H_2O or NH_4OH+Aq. (Rammelsberg.)
$+10H_2O$. (Norblad.)
$+16H_2O$. Efflorescent. (Rammelsberg.)
$+18H_2O$. (Ditte.)

Sodium *penta*vanadate, $Na_4V_{10}O_{27}+3\frac{1}{2}H_2O$.
Scarcely sol. in H_2O. (Rammelsberg.)

Sodium vanadate, $Na_6V_4O_{13}+6H_2O$.
Difficultly sol. in cold H_2O. (Carnelley, A. **166.** 155.)
$+2H_2O$. (Carnelley.)
$Na_6V_{16}O_{43}+24H_2O$. Correct formula for Norblad's *tri*vanadate. (Rammelsberg.)

Sodium vanadate, basic, $Na_8V_2O_9+26$ or $30H_2O$.
Very sol. in H_2O. (Ditte.)

Sodium vanadate fluoride, $2Na_3VO_4$, $NaF+19H_2O$.
Sol. in H_2O. (Rammelsberg, W. Ann. **20.** 928.)

Strontium *meta*vanadate, $Sr(VO_3)_2+4H_2O$.
Difficultly sol. in cold H_2O. (Norblad.)

Strontium *di*vanadate, $SrV_4O_{11}+9H_2O$.
Sl. sol. in H_2O, but much more sol. than barium *di*vanadate. (v. Hauer.)

Strontium *tri*vanadate, $SrV_6O_{16}+14H_2O$.
Sol. in H_2O, but decomposes slowly on boiling. Easily sol. in hot H_2O acidified with $HC_2H_3O_2$, and crystallises therefrom without decomp. (v. Hauer, J. pr. **76.** 156.)

Strontium *tetra*vanadate, $SrV_8O_{21}+11H_2O$.
Sol. in hot H_2O with partial decomposition. (Manasse, A. **240.** 34.)

Strontium vanadate, $Sr_3V_8O_{23}+14H_2O$.
Sol. in H_2O. (Manasse, A. **240.** 23.)
$Sr_4V_{14}O_{39}+30H_2O$. Sol. in H_2O. (Norblad.)

Thallous *meta*vanadate, $TlVO_3$.
Sol. in 11,534 pts. H_2O at 11°, and 4756 pts. at 100°. (Carnelley.)

Thallous *ortho*vanadate, Tl_3VO_4.
Sl. sol. in H_2O. Sol. in 999 pts. H_2O at 15°, and 574 pts. at 100°. (Carnelley, Chem. Soc. (2) **11.** 323.)

Thallous *pyro*vanadate, $Tl_4V_2O_7$.
Sol. in 4996 pts. H_2O at 14°, and 3840 pts. H_2O at 100°. (Carnelley.)

Thallous vanadate, $Tl_{12}V_8O_{26}$.
Sol. in 3406 pts. H_2O at 14°, and 3533 pts. at 100°. (Carnelley.)
$Tl_{12}V_{10}O_{31}$. Sol. in 9372 pts. H_2O at 11°, and 3366 pts. at 100°. (Carnelley.)
$Tl_{12}V_{14}O_{41}$. Ppt. (Carnelley.)

Thorium vanadate, $Th_3O_{12}(VO)_4$, $16V_2O_5+24H_2O$ (?).
Sol. in H_2O. (Cleve.)

Uranyl vanadate, $2UO_3$, V_2O_5, $(UO_2)_2V_2O_7$.
Insol. in H_2O. (Carnot, C. R. **104.** 1850.)

Vanadium vanadate, $2VO_2$, $V_2O_5=V_4O_9$.
Insol. in H_2O. Sol. in dil. H_2SO_4 or HNO_3+Aq. (Rammelsberg.)
Slowly oxidised by HNO_3+Aq. Slowly sol. in NH_4OH+Aq. Easily sol. in $HCl+Aq$. (Ditte, C. R. **101.** 1487.)
$+2\frac{2}{3}H_2O$. (Brierley.)
$2VO_2$, $2V_2O_5+8H_2O$. Insol. in H_2O. (Brierley, Chem. Soc. **49.** 31.)

Yttrium vanadate.
Precipitate. (Berzelius.)

Zinc vanadate, $Zn(VO_3)_2+2H_2O$.
Sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Zinc *pyro*vanadate, $Zn_2V_2O_7$.
Appreciably sol. in H_2O. (Ditte, C. R. **96.** 1048.)

Vanadicovanadic acid.

Ammonium vanadicovanadate, $(NH_4)_2O$, $2VO_2$, $4V_2O_5+8H_2O$.
Sl. sol. in cold and warm H_2O. (Gibbs, Am. Ch. J. **7.** 209.)
$(NH_4)_2O$, $2V_2O_4$, $2V_2O_5+14H_2O$. Sol. in H_2O. (Brierley, Chem. Soc. **49.** 30.)
$3(NH_4)_2O$, $2V_2O_4$, $4V_2O_5+6H_2O$. Insol. in H_2O. (Brierley.)

Potassium ——, $2K_2O$, $2V_2O_4$, $V_2O_5+6H_2O$.
Sol. in hot H_3O. (Brierley, Chem. Soc. **49.** 30.)
$5K_2O$, $2V_2O_4$, $4V_2O_5+H_2O$. Insol. in H_2O. (Brierley.)

Sodium ——, $2Na_2O$, $2V_2O_4$, $V_2O_5+13H_2O$.
Easily sol. in H_2O. Insol. in conc. solutions of salts, especially acetate. (Brierley, Chem. Soc. **49.** 30.)

Vanadioarsenic acid.

See **Arseniovanadic acid.**

Vanadioiodic acid.

See **Iodovanadic acid.**

Vanadiomolybdic acid, $8MoO_3, V_2O_5 + 5H_2O$.

Very sl. sol. in H_2O, and sl. sol. in boiling HNO_3+Aq. (Ditte, C. R. **102**. 757.)

Could not be obtained. (Friedheim, B. **24**. 1173.)

Ammonium vanadiomolybdate, $3(NH_4)_2O, 2V_2O_5, 4MoO_3+7H_2O$.

(Milch, Dissert. Berlin, **1887**.)

$+9H_2O$. Sol. in H_2O. (Ditte, C. R. **102**. 1019.)

$+11H_2O$. Easily sol. in H_2O. Correct composition of above compounds is $=(NH_4)_2O, 2V_2O_5 + 2[(NH_4)_2O, 2MoO_3] + 11H_2O$. (Friedheim, B. **24**. 1173.)

$2(NH_4)_2O, V_2O_5, 6MoO_3+5H_2O$. Sol. in a large amount of H_2O. (Gibbs, Am. Ch. J. **5**. 361.)

$+6H_2O$. Composition is double the above formula, or—

$4(NH_4)_2O, 2V_2O_5, 12MoO_3+12H_2O$. Rather difficultly sol. in H_2O. Composition is $(NH_4)_2O, 2V_2O_5+3[(NH_4)_2O, 4MoO_3]$. (Friedheim.)

$5(NH_4)_2O, 2V_2O_5, 12MoO_3+10H_2O$. Quite easily sol. in H_2O. Composition is $(NH_4)_2O, 2V_2O_5+4[(NH_4)_2O, 3MoO_3]+10H_2O$.

$6(NH_4)_2O, 3V_2O_5, 12MoO_3+21H_2O$. Sol. in H_2O. Composition is $(NH_4)_2O, 3V_2O_5+5(NH_4)_2O, 12MoO_3$. (F.)

$8(NH_4)_2O, V_2O_5, 18MoO_3+15H_2O$. Decomp. by hot H_2O. (Gibbs.) Could not be obtained. (Friedheim.)

$10(NH_4)_2O, 3V_2O_5, 24MoO_3+10H_2O$. Sol. in H_2O. (Milch.) Could not be obtained. (Friedheim.)

Ammonium barium ——, $5(NH_4)_2O, 15BaO, 6V_2O_5, 36MoO_3$.

(Milch.)

Barium ——, $3BaO, 2V_2O_5, 6MoO_3$.

(Milch.)

$3BaO, V_2O_5, 8MoO_3 + 2BaO, H_2O, V_2O_5, 8MoO_3+28H_2O$. Sol. in hot H_2O. (Gibbs, Am. Ch. J. **5**. 361.)

$7BaO, 3V_2O_5, 18MoO_3+16H_2O=BaO, 3V_2O_5+6(BaO, 3MoO_3)+16H_2O$. Sl. sol. in H_2O. (Friedheim.)

Potassium ——, $3K_2O, 2V_2O_5, 4MoO_3+8H_2O =K_2O, 2V_2O_5+2(K_2O, 2MoO_3)+8H_2O$.

Very sol. in H_2O. (Friedheim.)

$4K_2O, 2V_2O_5, 12MoO_3+12H_2O=K_2O, 2V_2O_5+3(K_2O, 4MoO_3)+12H_2O$. Sl. sol. in H_2O. (Friedheim.)

$5K_2O, 2V_2O_5, 12MoO_3+12H_2O=K_2O, 2V_2O_5+4(K_2O, 3MoO_3)+12H_2O$. Rather sl. sol. in H_2O. (Friedheim.)

Vanadiophosphoric acid.

See **Phosphovanadic acid.**

Vanadiosulphuric acid, $V_2O_5, 3SO_3+3H_2O$.

Deliquescent. Sol. in H_2O, but is decomp. by boiling. (Ditte, C. R. **102**. 757.)

See **Sulphate, vanadium.**

Vanadiotungstic acid, $6H_2O, V_2O_5, 10WO_3+16H_2O$.

Very sl. sol. in cold, more easily in hot H_2O. (Gibbs, Am. Ch. J. **5**. 361.)

$6H_2O, V_2O_5, 16WO_3+30H_2O$. Readily sol. in H_2O. (Gibbs.)

$17H_2O, 4V_2O_5, 16WO_3+24H_2O$. Sl. sol. in cold, easily in hot H_2O. (Rosenheim, A. **251**. 228.)

Aluminum sodium vanadiotungstate, $7Al_2O_3, 27Na_2O, 36V_2O_5, 144WO_3+504H_2O$.

$3(Al_2O_3, 9Na_2O, 48WO_3), 4(Al_2O_3, 9V_2O_5)+504H_2O$.

Sol. in H_2O. (Rothenbach, B. **23**. 3055.)

Ammonium ——, $(NH_4)_2O, 3V_2O_5, WO_3+6H_2O$.

Sol. in H_2O. (Rammelsberg, B. **1**. 158.)

$4(NH_4)_2O, 2H_2O, V_2O_5, 5WO_3+11H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **5**. 361.)

$2(NH_4)_2O, V_2O_5, 5WO_3+10H_2O$. Sol. in H_2O. (Ditte, C. R. **102**. 1019.)

$31(NH_4)_2O, 14V_2O_5, 60WO_3 + 58H_2O = 5[5(NH_4)_2O, 12WO_3], 2[3(NH_4)_2O, 7V_2O_5)]$. Sol. in H_2O. (Rothenbach, B. **23**. 3051.)

$7(NH_4)_2O, 4V_2O_5, 14WO_3+16H_2O$. Sol. in H_2O. (Rosenheim, A. **251**. 197.)

$8(NH_4)_2O, 4V_2O_5, 16WO_3, 9H_2O+4H_2O$. Efflorescent. Very sol. in H_2O. (Rosenheim, A. **251**. 216.)

Barium ——, $19BaO, 10V_2O_5, 36WO_3+94H_2O =3(5BaO, 12WO_3), 2(2BaO, 5V_2O_5)+94H_2O$.

Sl. sol. in H_2O. (Rothenbach, B. **23**. 3052.)

$8BaO, 4V_2O_5, 16WO_3, 9H_2O+44H_2O$. Efflorescent. Not very sol. in H_2O. (Rosenheim, A. **251**. 218.)

Composition is $6BaO, 12WO_3, 3V_2O_5+39H_2O$. (Friedheim.)

$4BaO, 4V_2O_5, 12WO_3+41H_2O$. Less sol. than preceding salt. Decomp. by boiling or by mineral acids. (Rosenheim.)

Composition is $4BaO, 12WO_3, 3V_2O_5+30H_2O$. (Friedheim.)

Magnesium sodium ——, $MgO, 6Na_2O, 3V_2O_5, 12WO_3 + 42H_2O = 5Na_2O, 12WO_3+MgO, Na_2O, 3V_2O_5+42H_2O$.

Sol. in H_2O. (Rothenbach, B. **23**. 3054.)

Potassium ——, $4K_2O, 3V_2O_5, 12WO_3+30H_2O$.

Sol. in H_2O.

Composition is potassium *meta*tungstate vanadate, $3(K_2O, 4WO_3)+K_2O, 3V_2O_5+30H_2O$. (Friedheim, B. **23**. 1515.)

$8K_2O, 4V_2O_5, 16WO_3, 9H_2O+24H_2O$. Very efflorescent. Easily sol. in H_2O. (Rosenheim, A. **251**. 214.)

Formula is $6K_2O, 12WO_3, 3V_2O_5+24H_2O$, which is a double salt, $5K_2O, 12WO_3+K_2O, 3V_2O_5$. (Friedheim, B. **23**. 1505.)

Silver ——, $8Ag_2O, 4V_2O_5, 16WO_3, 9H_2O$.

Somewhat sol. in cold H_2O, more easily upon addition of little HNO_3. Decomp. by warm H_2O. (Rosenheim, A. **251**. 224.)

$3Ag_2O, 2V_2O_5, 6WO_3+3H_2O$. Nearly insol. in cold H_2O. Decomp. by addition of HNO_3 or upon warming. (Rosenheim.)

Sodium ——, $5Na_2O, 3V_2O_5, 6WO_3+36H_2O$.

Sol. in H_2O.

Composition is $3(Na_2O, 2WO_3)+2(Na_2O, 3V_2O_5)+36H_2O$. (Friedheim, B. **23.** 1527.)

$2Na_2O, 2V_2O_5, 3WO_3+20H_2O$. Very sol. in H_2O.

Composition is $Na_2O, 3WO_3+Na_2O, 2V_2O_5+20H_2O$, double salt of sodium *tri*tungstate and *di*vanadate. (Friedheim, B. **23.** 1523.)

$4Na_2O, 3V_2O_5, 12WO_3+38H_2O=3(Na_2O, 4WO_3)+Na_2O, 3V_2O_5+38H_2O$. Sol. in H_2O. (Rothenbach, B. **23.** 3050.)

$8Na_2O, 4V_2O_5, 16WO_3, 9H_2O+48H_2O$. Efflorescent. Easily sol. in H_2O. (Rosenheim, A. **251.** 210.)

Formula is $6Na_2O, 12WO_3, 3V_2O_5+42H_2O$, and is a double salt of sodium *para*tungstate, $5Na_2O, 12WO_3$, and sodium *tri*vanadate, $Na_2O, 3V_2O_5$. (Friedheim, B. **23.** 1505.)

Strontium vanadiotungstate, $19SrO, 36WO_3, 10V_2O_5+122H_2O=3(5SrO, 12WO_3), 2(2SrO, 5V_2O_5)+122H_2O$.

Sol. in H_2O. (Rothenbach, B. **23.** 3053.)

Vanadious acid.

See **Hypovanadic acid.**

Vanadiovanadicomolybdic acid.

Ammonium vanadiovanadicomolybdate, $11(NH_4)_2O, 4V_2O_5, VO_2, 28MoO_3+48H_2O$.

Sl. sol. in cold, sol. in hot H_2O without decomp. (Gibbs, Am. Ch. J. **5.** 391.)

Barium ——, $14BaO, 2V_2O_5, 3VO_2, 30MoO_3+48H_2O$.

Precipitate. Very sl. sol. in cold, decomp. by hot H_2O. (Gibbs.)

Vanadiovanadicotungstic acid.

Ammonium vanadiovanadicotungstate, $6(NH_4)_2O, 2V_2O_5, 3VO_2, 12WO_3+12H_2O$.

Sol. in H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

Silver ——, $6Ag_2O, 2V_2O_5, 3VO_2, 12WO_3+8H_2O$.

Precipitate. Very sl. sol. in cold, sol. in much warm H_2O. (Gibbs.)

Sodium ——, $6Na_2O, 2V_2O_5, 3VO_2, 12WO_3$.

Very sol. in H_2O. (Gibbs.)

Vanadium, V.

Insol. in H_2O, HCl, dil. H_2SO_4+Aq, and cold conc. H_2SO_4. Sol. in hot conc. H_2SO_4. Slowly sol. in HF+Aq. Easily sol. in dil. or conc. HNO_3+Aq. Not attacked by hot or cold NaOH or KOH+Aq. (Roscoe, A. suppl. **7.** 85.)

Vanadium *tri*bromide, VBr_3.

Very deliquescent; quickly decomposes. (Roscoe, A. suppl. **8.** 99.)

Vanadium *di*chloride, VCl_2.

Very deliquescent. Sol. in H_2O, alcohol, and ether. (Roscoe, A. suppl. **7.** 79.)

Vanadium *tri*chloride, VCl_3.

Deliquescent. Sol. in H_2O, absolute alcohol, and ether.

Vanadium *tetra*chloride, VCl_4.

Sol. with decomp. in H_2O, alcohol, and ether. (Roscoe.)

Vanadium *sesqui*fluoride, $V_2F_6+6H_2O$.

Efflorescent. Easily sol. in cold, extremely sol. in hot H_2O with decomp. Can be recryst. from HF + Aq. Insol. in strong alcohol. (Petersen, J. pr. (2) **40.** 48.)

Vanadium *sesqui*fluoride *with* MF.

See **Fluovanadate, M.**

Vanadium *di*hydroxide, VO, xH_2O.

Insol. in KOH or NaOH+Aq.

Vanadium *tri*hydroxide, V_2O_3, xH_2O.

Easily sol. in all acids. (Petersen, J. pr. (2) **40.** 49.)

Vanadium *tetra*hydroxide (Hypovanadic hydroxide), $V_2O_2(OH)_4+5H_2O$.

Easily sol. in acids or alkalies. (Crow, Chem. Soc. **30.** 453.)

Vanadium nitride, VN.

(Roscoe, A. suppl. **6.** 114.)

VN_2. Not attacked by cold HNO_3+Aq. (Uhrlaub, Pogg. **103.** 134.)

Vanadium *di*oxide, VO.

Insol. in H_2O, easily sol. in dil. acids. (Roscoe, A. suppl. **6.** 95.)

Vanadium *tri*oxide, V_2O_3.

Oxidised in H_2O in contact with air and then dissolves. Insol. in acids, except HNO_3, and in alkalies + Aq. (Roscoe, A. suppl. **6.** 99.)

Easily sol. in HF. (Petersen, J. pr. (2) **40.** 48.)

Vanadium *tet*roxide, VO_2.

Sol. in acids and alkalies + Aq.

Vanadium *pent*oxide, V_2O_5.

Sol. in about 1000 pts. H_2O. (Berzelius.)

Sol. in acids, alkali hydrates, and carbonates + Aq. Insol. in absolute, very sl. sol. in dil. alcohol.

Insol. in glacial $HC_2H_3O_2$.

Sol. in conc. KF+Aq. (Ditte, C. R. **105.** 1067.)

Sol. in $H_2C_2O_4$+Aq and alkali oxalates + Aq. (Halberstadt, Z. anal. **22.** 1.)

Three modifications.—(α) Forms hydrates with 2, and $5H_2O$. Sol. in H_2O. 1 l. of sat. solution contains 8 g. V_2O_5.

(β) $V_2O_5, 2H_2O$. Very sl. sol. in H_2O. 1 l. of sat. solution contains 0·5 g. V_2O_5.

(γ) $V_2O_5, 5H_2O$. Less sol. in H_2O than β. 1 l. H_2O contains 0·05 g. V_2O_5 when saturated. (Ditte, C. R. **101.** 698.)

See **Vanadic acid.**

Vanadium oxide, $V_4O_9=2VO_2, V_2O_5$.

See **Vanadate, vanadium.**

$V_2O_4, V_2O_5+\frac{2}{3}H_2O$. (Brierley, Chem. Soc. **49.** 30.)

See also **Vanadiovanadic acid.**

$V_2O_4, 2V_2O_5+8H_2O$.

See **Vanadate, vanadium.**

Vanadium *pent*oxide *with* MF.
See **Fluoxyvanadate, M.**

Vanadium oxy- compounds.
See **Vanadyl compounds.**

Vanadium *di*sulphide, V_2S_2.

Insol. in boiling dil. or conc. HCl, dil. H_2SO_4+Aq, or cold conc. H_2SO_4. Easily sol. in hot dil. or conc. HNO_3+Aq, or in boiling conc. H_2SO_4. Insol. in alkalies+Aq. Sl. sol. in KSH+Aq; sol. in NH_4SH+Aq. (Kay, Chem. Soc. **37.** 728.)

Vanadium *tri*sulphide, V_2S_3.

Insol. in cold HCl or dil. H_2SO_4+Aq. Very sl. sol. in hot HCl or dil. H_2SO_4+Aq. More sol. in HNO_3+Aq or conc. H_2SO_4. Sl. sol. in NaOH or NH_4OH+Aq. Easily sol. in $(NH_4)_2S$ or NH_4SH+Aq, also in K_2S+Aq. (Kay, Chem. Soc. **37.** 728.)

Vanadium *penta*sulphide, V_2S_5.

Sl. attacked by hot conc. HCl or hot dil. H_2SO_4+Aq; sol. in hot conc. H_2SO_4. Sol. in hot dil. HNO_3+Aq. Sl. sol. in NH_4OH+Aq, but easily dissolved by NaOH+Aq. Sl. sol. in Na_2S+Aq. Sol. in NH_4SH+Aq. (Kay.)

Vanadous acid.

See **Hypovanadic acid.**

Vanadovanadic acid.

See **Vanadicovanadic acid.**

Vanadyl *di*bromide, $VOBr_2$.

Very deliquescent, and sol. in H_2O. (Roscoe.)

Vanadyl *tri*bromide, $VOBr_3$.

Very deliquescent, and quickly decomposes in moist air. Sol. in H_2O. (Roscoe.)

Vanadyl bromide, $V_2O_3Br_2$, 2HBr+$7H_2O$.

Very deliquescent. (Ditte, C. R. **102.** 1310.)

Vanadyl *semi*chloride, V_2O_2Cl.

Insol. in H_2O. Easily sol. in HNO_3+Aq. (Roscoe, A. suppl. **6.** 114.)

Vanadyl *mono*chloride, VOCl.

Insol. in H_2O. Easily sol. in HNO_3+Aq. (Roscoe.)

Vanadyl *di*chloride, $VOCl_2$.

Deliquescent. Slowly decomp. by H_2O. Easily sol. in HNO_3+Aq. (Roscoe.)

Vanadyl *tri*chloride, $VOCl_3$.

Deliquescent. Sol. in H_2O and alcohol with decomp. (Bedson, A. **180.** 235.)
Sol. in ether with combination.

***Di*vanadyl chloride,** $V_2O_4Cl_2+5H_2O$.

Deliquescent, and sol. in H_2O, fuming HCl, or alcohol. (Crow, Chem. Soc. **30.** 457.)

Vanadyl chloride, $V_2O_3Cl_2+4H_2O$.

Very deliquescent. (Ditte, C. R. **102.** 1310.)

Vanadyl platinum chloride.
See **Chloroplatinate, vanadyl.**

Vanadyl *tri*chloride ammonia, $VOCl_3$, $x NH_3$.

Decomp. by H_2O. (Roscoe.)

Vanadyl fluoride *with* MF.
See **Fluoxyvanadate,** *and* **Fluoxyhypovanadate, M.**

Vanadyl iodide, $V_2O_3I_2$, 3HI+$10H_2O$.

Very deliquescent, and sol. in H_2O. (Ditte, C. R. **102.** 1310.)
$V_2O_3I_2$, 2HI+$8H_2O$. As above.

Vanadyl sulphide, VOS (?).

(*a*) Insol. in H_2O, alkalies, alkali sulphides, and acids, except nitric acid and aqua regia. (Berzelius.)
(*b*) Sol. in alkalies, alkali carbonates, and sulphides+Aq. Insol. in acids. (Berzelius.)

Water, H_2O.

Water is the most universal solvent. It absorbs all gases, usually with an increase of volume, seldom, as in the case of NH_3, with a diminution of volume. It dissolves almost all solids in greater or less quantity, and mixes with or dissolves considerable amounts of many liquids.
Miscible with alcohol. Sol. in 36 pts. ether.
Sol. in 30-33 vols. ethyl acetate. (Becker.)
Sol. in 5 vols. iodhydrin.
Sl. sol. in most of the fatty oils.

White precipitate, fusible.

See **Mercuri*di*ammonium chloride.**

White precipitate, infusible.
See **Mercuric chloramide.**

Xanthochromium bromide, $Cr(NO_2)(NH_3)_5Br_2$.

Sol. in H_2O. Resembles the chloride. (Christensen, J. pr. (2) **24.** 74.)

—— **carbonate,** $Cr(NO_2)(NH_3)_5CO_3$.

Easily sol. in H_2O. (Christensen.)

—— **chloride,** $Cr(NO_2)(NH_3)_5Cl_2$.

More sol. in H_2O than the roseo, but less than the purpureo salt.
Solution decomp. by light or boiling. Decomp. by dil. acids. Sol. in NaOH+Aq and in NH_4OH+Aq (sp. gr. 0·91). Insol. in alcohol. (Christensen, J. pr. (2) **24.** 74.)

—— **chloroplatinate,** $Cr(NO_2)(NH_3)_5PtCl_6$.

Insol. in pure H_2O, but sol. when warmed with H_2O containing HCl, with formation of a new double salt. (Christensen.)

—— **mercuric chloride,** $Cr(NO_2)(NH_3)_5Cl_2$, $2HgCl_2$.

Precipitate. Decomp. by long contact with H_2O. (Christensen.)

—— **chromate,** $Cr(NO_2)(NH_3)_5CrO_4$.

Difficultly sol. in H_2O. (Christensen.)

—— ***di*chromate,** [illegible]

Difficultly [illegible]

—— **dithio**[illegible]

Insol. in [illegible]

—— **hydro**[illegible]

Known [illegible]

Xanthochromium iodide, $Cr(NO_2)(NH_3)_5I_2$.
Quite difficultly sol. in H_2O. (Christensen.)

—— **nitrate,** $Cr(NO_2)(NH_3)_5(NO_3)_2$.
Sol. in about 150 pts. H_2O. (Christensen.)

—— **sulphate,** $Cr(NO_2)(NH_3)_5SO_4+H_2O$.
Sol. in H_2O and $(NH_4)_2SO_4+Aq$. (Christensen.)

Xanthocobaltic bromide,
$Co(NH_3)_5(NO_2)Br_2$.
Easily sol. in cold H_2O. (Werner and Miolati, Gazz. ch. it. **23**, **2**. 140.)

—— **bromonitrate,** $Co(NO_2)(NH_3)_5(NO_3)Br$.
Sl. sol. in cold, more easily in hot H_2O. (Gibbs.)

—— **chloride,** $Co(NO_2)(NH_3)_5Cl_2$.
Sl. sol. in cold H_2O, and decomp. by boiling therewith. Insol. in $HCl+Aq$, and alkali chlorides+Aq. Easily decomp. by boiling with acids, even dilute. (Gibbs and Genth.)
Sol. in 50 pts. cold H_2O. (Jörgensen, Z. anorg. **5**. 172.)

—— **mercuric chloride,** $Co(NO_2)(NH_3)_5Cl_2$, $2HgCl_2+H_2O$.
Insol. in cold, sl. sol. in hot H_2O without decomp. More sol. in acidified H_2O. (Gibbs and Genth.)

—— **chloraurate,** $Co(NO_2)(NH_3)_5Cl_2$, $AuCl_3+H_2O$.
Can be easily crystallised out of hot H_2O. (Gibbs and Genth, Sill. Am. J. (2) **24**. 90.)

—— **chloronitrate,** $Co(NO_2)(NH_3)_5(NO_3)Cl$.
Sl. sol. in cold, more easily in hot H_2O.

—— **chloronitrate gold chloride,**
$Co(NO_2)(NH_3)_5(NO_3)Cl$, $AuCl_3$.

—— **chloronitrate platinic chloride,**
$2Co(NO_2)(NH_3)_5(NO_3)Cl$, $PtCl_4$.

—— **chloroplatinate,** $Co(NO_2)(NH_3)_5Cl_2, PtCl_4+H_2O$.
Scarcely sol. in hot or cold H_2O. Can be recryst. from dil. HNO_3+Aq. Sol. in hot dil. $HCl+Aq$. (Gibbs and Genth, Sill. Am. J. (2) **24**. 91.)

—— **chromate,** $Co(NO_2)(NH_3)_5CrO_4+H_2O$.
Very sl. sol. in cold, and but slightly sol. in hot H_2O. (Gibbs.)

—— *di***chromate,** $Co(NO_2)(NH_3)_5Cr_2O_7$.
Easily sol. in hot H_2O.

—— **ferrocyanide,** $[Co(NO_2)(NH_3)_5]_2Fe(CN)_6+7H_2O$.
Nearly insol. in cold, decomp. by warm H_2O.
$+6H_2O$. (Braun, A. **132**. 47.)

—— **iodide,** $Co(NO_2)(NH_3)_5I_2$.
Sol. in H_2O. (Gibbs.)

Xanthocobaltic iodosulphate,
$[Co(NO_2)(NH_3)_5]_2(SO_4)I_2$.
Sol. in H_2O.

—— *per***iodosulphate,** $[Co(NO_2)(NH_3)_5]_2(SO_4)I$.
Easily decomp. by hot H_2O.

—— **nitrate,** $Co(NO_2)(NH_3)_5(NO_3)_2$.
Sl. sol. in cold, moderately sol. in hot H_2O. Decomp. by boiling. Much less sol. than NH_4Cl or $(NH_4)_2SO_4$ in cold H_2O. Insol. in HNO_3. (Gibbs and Genth.)

—— **nitrite,** $Co(NO_2)(NH_3)_5(NO_2)_2+2H_2O$.
Sol. in H_2O. (Gibbs.)

—— **cobaltic nitrite,** $Co(NO_2)(NH_3)_5(NO_2)_3+2H_2O$.
Sl. sol. in H_2O. (Gibbs, Proc. Am. Acad. **11**. 8.)
Is nitratopurpureocobaltic cobaltic nitrite, $[(NO_3)Co(NH_3)_5]_3[Co(NO_2)_6]_2+2H_2O$. (Jörgensen, Z. anorg. **5**. 175.)
$[Co(NO_2)(NH_3)_5]_3[Co(NO_2)_6]_2$. Not so difficultly sol. as the luteo salt. (Jörgensen.

—— *tetr***amine cobaltic nitrite,**
$Co_2(NO_2)_2(NH_3)_{10}[Co_2(NH_3)_4(NO_2)_8]_2$.
Can be recryst. from hot H_2O. (Gibbs, Proc. Am. Acad. **11**. 8.)
$=(NO_2)Co(NH_3)_5[(NO_2)_2(NH_3)_2Co(NO_2)_2]_2$. Xanthocobaltic *di*amine cobaltic nitrite. Very sl. sol. in cold H_2O. (Jörgensen, Z. anorg. **5**. 180.)

—— **oxalate,** $Co(NO_2)(NH_3)_5C_2O_4$.
Nearly insol. in cold, sl. sol. in hot H_2O.

—— **sulphate,** $Co(NO_2)(NH_3)_5SO_4$.
Moderately sol. in hot, much less in cold H_2O. Sol. without decomp. in H_2SO_4+Aq. (Gibbs and Genth.)
Sol. in 25 pts. hot H_2O acidified with $HC_2H_3O_2$. (Jörgensen, Z. anorg. **5**. 172.)
$4Co(NO_2)(NH_3)_5SO_4$, $3H_2SO_4$. Decomp. by H_2O, not by absolute alcohol. (Jörgensen.)

Xanthorhodium bromide,
$(NO_2)Rh(NH_3)_5Br_2$.
Moderately sol. in H_2O. (Jörgensen, J. pr. (2) **34**. 394.)

—— **chloride,** $(NO_2)Rh(NH_3)_5Cl_2$.
Much more sol. in H_2O than the nitrate.

—— **chloroplatinate,** $(NO_2)Rh(NH_3)_5PtCl_6$.
Ppt. Extremely sl. sol. in cold H_2O.

—— **dithionate,** $(NO_2)Rh(NH_3)_5S_2O_6+H_2O$.
Nearly insol. in H_2O.

—— **fluosilicate,** $(NO_2)Rh(NH_3)_5SiF_6$.
Ppt.

—— **hydroxide,** $(NO_2)Rh(NH_3)_5(OH)_2$.

—— **nitrate,** $(NO_2)Rh(NH_3)_5(NO_3)_2$.
Moderately sol. in cold, easily in hot H_2O. Insol. in alcohol. Less sol. in conc. NH_4OH+Aq than in H_2O.
Insol. in dil. HNO_3+Aq; sol. in HNO_3+Aq of 1·4 sp. gr.

Xanthorhodium oxalate,
$(NO_2)Rh(NH_3)_5C_2O_4$.

Nearly insol. in cold H_2O. Very sl. sol. in warm H_2O. Easily sol. in dil. $HC_2H_3O_2$+Aq.

—— **sulphate,** $(NO_2)Rh(NH_3)_5SO_4$.

Slowly sol. in cold, quite easily in hot H_2O.

$4(NO_2)Rh(NH_3)_5SO_4$, $3H_2SO_4$. Sl. sol. in cold, easily in hot H_2O. Can be recrystallised from dil. H_2SO_4+Aq.

Ytterbium, Yb.

Not isolated.

Ytterbium oxide, Yb_2O_3.

Slowly attacked by cold or warm acids, but easily sol. at 100°.

Yttrium, Y.

Decomposes H_2O. (Cleve, Bull. Soc. (2) **21.** 344.) Decomp. H_2O slightly at ord. temp., more rapidly by boiling. Easily sol. in dil. acids, even acetic acid. Slightly acted upon by conc. H_2SO_4. Decomposes hot KOH+Aq and cold NH_4Cl+Aq. Not attacked by NH_4OH+Aq. (Popp, A. **131.** 179.)

Popp's yttrium contained erbium.

Yttrium bromide, YBr_3.

Sol. in H_2O with evolution of heat. (Duboin, C. R. **107.** 243.)

+$9H_2O$. Deliquescent. Easily sol. in H_2O and alcohol. Insol. in ether. (Cleve.)

Yttrium chloride, YCl_3.

Anhydrous. Sol. in H_2O with evolution of heat. (Cleve.)

+$6H_2O$. Deliquescent. Very sol. in H_2O. Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Yttrium fluoride, $YF_3+\frac{1}{2}H_2O$.

Nearly insol. in dil. acids. (Cleve.)

Yttrium hydroxide, Y_2O_3, $6H_2O$ or $Y_2O_6H_6$+$3H_2O$.

Insol. in H_2O.

Insol. in KOH or NaOH+Aq. Easily sol. in acids. Sol. in alkali carbonates+Aq. When freshly pptd., easily sol. in NH_4Cl+Aq.

Yttrium iodide, YI_3.

Very deliquescent. Easily sol. in H_2O and alcohol.

Sl. sol. in ether. (Cleve.)

Yttrium oxide, Y_2O_3.

Insol. in H_2O. Sl. sol. in cold HCl, HNO_3, or dil. H_2SO_4+Aq, but gradually completely sol. on warming. Insol. in NH_4OH and sl. sol. in KOH+Aq. Sol. in $HC_2H_3O_2$+Aq. Somewhat sol. in K_2CO_3+Aq.

Yttrium *per*oxide, Y_4O_9.

(Cleve, Bull. Soc. (2) **43.** 53.)

Yttrium oxychloride, $Y_2O_2Cl_2$.

Insol. in H_2O. (Popp.)

Yttrium sulphide, Y_2S_3.

Not prepared in pure state. Impure is insol. in H_2O, and partially decomp. thereby. Easily sol. in acids with decomp. (Popp.)

Zinc, Zn.

Not attacked by pure cold H_2O. Slowly oxidised by boiling H_2O. Pure H_2O free from O dissolved nothing from 2500 sq. mm. Zn. Presence of air containing CO_2 caused a solution of 3·5 mg. Zn, which maximum was reached in 2 days. Air without CO_2 also caused a slight action. (Snyders, B. **11.** 936.)

100 ccm. distilled H_2O dissolved 14 mg. Zn from 11·8 sq. cm. in one week, during which air free from CO_2 was passed through the liquid, and 19 mg. when air containing CO_2 was used. (Wagner, Dingl. **221.** 260.)

Filtered rain water was found to contain 20 mg. Zn per l. (Burg, Isis, **1873.** 119.)

Sol. in all acids. Very slowly sol. in dil. HCl or H_2SO_4+Aq in glass vessels if Zn is pure. According to Jacquelain, 24 hours were necessary to dissolve 6 g. pure zinc. When fused at the lowest possible temperature, it is much more slowly sol. than when heated to a red heat. In both cases it is much more rapidly dissolved if cooled quickly. (Bolley, A. **95.** 294; Rammelsberg.)

Dil. H_2SO_4+Aq dissolves given % zinc in the same length of time (B = according to Bolley, R = according to Rammelsberg):

	Slowly cooled		Rapidly cooled	
	B	R	B	R
Cast at the melting point . .	42·5	74·1	13·0	0·9
Cast at a red heat	100·0	69·4	85·5	9·5

50 ccm. H_2SO_4+Aq dissolved in 2 hours the following amts. from 1 sq. cm. Zn at t°.

t°	Strength of acid	Grms. dissolved
20	H_2SO_4	0·000
130	,,	0·075
150	,,	0·232
20	$H_2SO_4+H_2O$	0·002
130	,,	0·142
150	,,	0·345
20	$H_2SO_4+2H_2O$	0·002
130	,,	4·916
150	,,	5·450
20	$H_2SO_4+3H_2O$	0·005
130	,,	3·080
20	$H_2SO_4+4H_2O$	0·049
130	,,	0·456
20	$H_2SO_4+5H_2O$	0·027
130	,,	0·337
20	$H_2SO_4+6H_2O$	0·018
100	,,	3·16

(Calvert and Johnson, Chem. Soc. **19.** 437.)

C.P. zinc is more quickly sol. in dil. acids in vacuo than under normal pressure, the ratio being about 1:6·5. The rate of solubility increases slowly with rise of temp. from 0° to 98°, when it amounts to about 4 times that at 0°, but from 98°-100° the increase is thirteenfold. Thus, as an average of 6 experiments, dil. H_2SO_4+Aq (1:20) dissolves in 30 minutes 2·1 mg. Zn at 0°; 4·9 mg. at 20°; 7·4 mg. at 60°; 9·3 mg. at 98°; but 122·1 mg. at 100°. If, however, the acid was prevented from boiling by increasing the pressure, the sudden increase between 98° and 100° does not take place.

The rate of solubility in dil. H_2SO_4+Aq (1:20) is also increased 175 times by the addition of CrO_3 and 306 times by the addition of H_2O_2. The above phenomena are explained by assuming the formation of a condensed hydrogen atmosphere around the metal, which prevents the further action of the acid. (Weeren, B. **24.** 1785.)

Not attacked by HNO_3+Aq of 1·512 to 1·419 sp. gr. at a temp. of −18° or less, but violently attacked if temp. is raised. HNO_3+Aq of 1·419-1·401 sp. gr. does not attack Zn at temp. of a freezing mixture, but violently at 0°. More dil. HNO_3+Aq attacks Zn even at −20°. (Millon, A. ch. (3) **6.** 99.)

Sol. in H_2CO_3+Aq. (Berzelius.)

Solubility of Zn in acids is very much affected by the presence of small quantities of various metallic salts. Small amts. of $PtCl_4$+Aq accelerated the action of H_2SO_4+Aq 149 times, and As_2O_3 123 times. $HgCl_2$ has a strong retarding action owing to pptn. of Hg on the Zn.

Various saline solutions have a strong solvent power in presence of $PtCl_4$, *i.e.* KCl, NaCl, Na_2SO_4, K_2SO_4, $MgSO_4$+Aq. $PtCl_4$ also causes Zn to decompose distilled H_2O. $CuSO_4$ has a similar but less energetic effect.

In all the above cases, the disengagement of hydrogen is slower in the dark than in the light. (Millon, C. R. **21.** 37.)

According to Barreswill (C. R. **21.** 292) the above reactions are all caused by galvanic action due to pptd. metal, and a piece of Pt in contact with the Zn causes the same action as the $PtCl_4$ in solution.

Easily sol. in alkalies+Aq, even NH_4OH+Aq, especially when the Zn is in contact with Fe. Sol. in NaCl+Aq with pptn. of ZnO. (Siersch, J. B. **1867.** 257.)

Sol. in sat. alkali and alkali-earth chlorides+Aq. (Post, **1872.**)

Sol. in NH_4 salts+Aq. (Lorin, J. B. **1865.** 124.)

Sol. in sat. Na_2SO_4, K_2SO_4, $MgSO_4$, $NaNO_3$, KNO_3, $Ba(NO_3)_2$, $CaCl_2$, $MgCl_2$, and NH_4NO_3+Aq. Chlorides and sulphates (especially Na_2SO_4 and $MgCl_2$) have strongest action, $MgSO_4$ and nitrates the least. The action was greatly increased by heat. (Snyders, B. **11.** 936.)

Sol. in boiling NH_4Cl+Aq. Sol. in neutral $FeCl_2$+Aq with pptn. of Fe, especially easily at 100°. (Capitaine, C. R. **9.** 737.)

Sol. in $NiSO_4$+Aq with pptn. of NiO. (Tupputi.)

Sol. in conc. hot $ZnCl_2$+Aq, but Zn oxychloride is pptd. on diluting. (Ordway, Am. J. Sci. (2) **23.** 222.)

Sol. in $GlSO_4$+Aq. (Debray.)

Solubility of Zn in dilute solutions of salts: 100 ccm. of solutions of the given salts were allowed to act one week on 11·8 sq. cm. Zn while a current of air with or without CO_2 was passed through the solution.

Salt.	G. salt in 100 ccm. solution.	Mg. Zn dissolved without CO_2	Mg. Zn dissolved with CO_2
NaCl or KCl	0·5	7	38
NH_4Cl	1·0	51	36
$MgCl_2$	0·83	18	54
K_2SO_4	1·0	30	53
KNO_3	1·0	9	37
Na_2CO_3	1·0	13	...
NaOH	0·923	60	...
CaO_2H_2	Sat.	3	...

(Wagner, Dingl. **221.** 260.)

Action of dil. salt solutions (1 %) on Zn. The following amts. of Zn in mg. were dissolved from 2500 sq. mm. Zn in 14 days by 400 ccm. 1 % solution of the given salts:

Salt	Mg. Zn	Salt	Mg. Zn
NaCl . .	11·2	$NaNO_3$. .	6
KCl. . .	14·8	$Ba(NO_3)_2$.	8
$CaCl_2$ . .	15·2	NH_4Cl. .	24·0
$MgCl_2$ . .	17·2	$(NH_4)_2SO_4$	31·6
$BaCl_2$ . .	13·2	NH_4NO_3 .	26·0
K_2SO_4 . .	12·0	$NaHCO_3$.	0
$MgSO_4$. .	8·8	K_2CO_3 . .	0
KNO_3 . .	6·8	Na_2CO_3 .	0

The presence of O hastens the action of salts+Aq, but CO_2 retards it. The action is much increased by increasing the temp. At 0° it is very slight. (Snyders, B. **11.** 936.)

Attacked by cane sugar+Aq at 115°. (Klein and Berg, C. R. **102.** 1170.)

Zinc amide, $Zn(NH_2)_2$.

Decomp. by H_2O and alcohol. Insol. in ether. (Frankland, Phil. Mag. (4) **15.** 149.)

Zinc antimonide, ZnSb.

Does not decomp. boiling H_2O except slightly. Not attacked by dil. mineral acids, but decomp. by conc. HCl or HNO_3+Aq. (Cooke, Proc. Am. Acad. **5.** 348.)

Zn_3Sb_2. Decomp. H_2O rapidly at 100°. Violently decomp. by dil. HCl or H_2SO_4+Aq, also by HNO_3+Aq. Completely sol. in HCl+Aq mixed with a little HNO_3. (Cooke.)

Zinc bromide, $ZnBr_2$.

Very deliquescent, and sol. in H_2O.

Sp. gr. of $ZnBr_2$+Aq at 19·5° containing:

18·3	31·7	43·2 % $ZnBr_2$,
1·1849	1·3519	1·5276
52·6	59·1	68 % $ZnBr_2$.
1·7082	1·8525	2·1027

(Kremers, Pogg. **108.** 117.)

Sp. gr. of $ZnBr_2$+Aq at 19·5°.

% $ZnBr_2$	Sp. gr.	% $ZnBr_2$	Sp. gr.	% $ZnBr_2$	Sp. gr.
5	1·045	25	1·265	45	1·560
10	1·093	30	1·330	50	1·650
15	1·196	35	1·400	55	1·755
20	1·204	40	1·475	60	1·875

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sol. in conc. HCl or $HC_2H_3O_2$+Aq, also in NH_4OH+Aq. Sol. in alcohol and ether. (Berthemot, J. Pharm. **14.** 610.)

Zinc bromide ammonia, $ZnBr_2$, $2NH_3$.

Decomp. by H_2O. Sl. sol. in cold, more easily in warm NH_4OH+Aq. (Rammelsberg, Pogg. **55.** 240.)

+$\frac{1}{3}H_2O$. Decomp. by H_2O with separation of ZnO. (André, C. R. **96.** 703.)

+H_2O. Above salt of Rammelsberg's has this composition. (André.)

$3ZnBr_2$, $8NH_3+2H_2O$. Decomp. by H_2O. (André.)

$3ZnBr_2$, $10NH_3+H_2O$. Decomp. by H_2O. (André.)

$2ZnBr_2$, $10NH_3$. Efflorescent. Decomp. by H_2O. (André.)

Zinc chloride, $ZnCl_2$.

Very deliquescent, and sol. in H_2O.

Sol. in 0·333 pt. H_2O at 18·75°. (Abl.)

$ZnCl_2$+Aq sat. at 12·5° contains 78·5 % $ZnCl_2$. (Hassenfratz, A. ch. **28.** 291.)

Sp. gr. of $ZnCl_2$+Aq at 19·5°.

% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.
13·8	1·1275	37·5	1·3869
25·8	1·2466	49·2	1·5551

(Kremers, Pogg. **105.** 360.)

Sp. gr. of $ZnCl_2$+Aq at 19·5°.

% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.
1	1·010	25	1·238	45	1·488
5	1·045	30	1·291	50	1·566
10	1·091	35	1·352	55	1·650
15	1·137	40	1·420	60	1·740
20	1·186	...	...	...	...

(Gerlach, Z. anal. **8.** 283, calculated from Kremers.)

Easily sol. in hot absolute alcohol, and ether. Sol. in 1 pt. strong alcohol at 12·5°. (Wenzel.)

Sol. in 0·35 pt. absolute alcohol. (Graham.)

Sol. in butyl (Wurtz), and hexyl (Bouis) alcohol at ord. temp., but decomp. on heating.

Very sol. in acetic ether with evolution of heat. (Cann, C. R. **102.** 363.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

+H_2O. Very deliquescent. Contains $1\frac{1}{2}H_2O$. (Engel, C. R. **102.** 1111.)

+$2H_2O$. (Engel.)

+$3H_2O$. Sol. in 12·5 pts. H_2O at 0°. (Engel.)

Zinc hydrogen chloride, $2ZnCl_2$, $HCl+2H_2O$.

Deliquescent. (Engel, C. R. **102.** 1068.)

$ZnCl_2$, $HCl+2H_2O$. (Engel.)

Zinc chloride ammonia, $ZnCl_2$, $5NH_3+H_2O$.

Easily sol. in little, but decomp. by much H_2O. Still more sol. in $ZnCl_2$+Aq with decomp. (Divers, C. N. **18.** 13.)

$ZnCl_2$, $4NH_3+H_2O$. (Kane.)

$ZnCl_2$, $2NH_3$. Not completely sol. in H_2O; can be recryst. from hot NH_4Cl+Aq. (Ritthausen, J. pr. **60.** 473.)

Insol. in H_2O. Sol. in NH_4Cl or NH_4OH+Aq. (Thoms, B. **20.** 743.)

$ZnCl_2$, NH_3. Decomp. by H_2O. (Kane, A. ch. **72.** 290.)

Zinc chloride hydroxylamine, $ZnCl_2$, $2NH_2OH$.

Sl. sol. in cold, somewhat more in warm H_2O. Very sol. in NH_2OH+Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) **3.** 116.)

Zinc fluoride, ZnF_2.

Sl. sol. in cold, more easily in hot H_2O. Insol. in 95 % alcohol. Sol. in boiling HNO_3, HCl, or H_2SO_4. (Poulenc, C. R. **116.** 581.)

+$4H_2O$. Difficultly sol. in H_2O. Somewhat more sol. in H_2O containing HF, HCl, or HNO_3. Easily sol. in NH_4OH+Aq. (Berzelius, Pogg. **1.** 26.)

Zinc hydrogen fluoride.

Known only in solution.

Zinc zirconium fluoride.

See **Fluozirconate, zinc.**

Zinc hydroxide, ZnO_2H_2.

Insol. in H_2O. Sol. in acids. Sol. in KOH, NaOH, NH_4OH, or $(NH_4)_2CO_3$+Aq.

Freshly pptd. ZnO_2H_2 is sol. in dil. salt solutions (1 %) as follows. The given amts. in mg. (calculated as Zn) were dissolved per l. at t°.

Salt	Mg. Zn	t°
NaCl	51	18
KCl	43	20
$CaCl_2$	57·5	16
$MgCl_2$	65	16
$BaCl_2$	38	18
K_2SO_4	37·5	20
$MgSO_4$	27	21
KNO_3	17·5	15
$NaNO_3$	22	15
$Ba(NO_3)_2$	25	21
K_2CO_3	0	15
NH_4Cl	95	20
NH_4NO_3	77	20
$(NH_4)_2SO_4$	88	20

(Snyders, B. **11.** 936.)

+H_2O.

See also **Zinc oxide.**

Zinc hydrosulphide, $Zn(SH)_2$.

Very unstable. Decomp. by H_2O. (Zott M. **10.** 807.)

Sol. in NaSH+Aq. (Thomsen, B. 11. 2044.)

$Zn_3H_2S_4$. (Zotta.)

Zinc iodide, ZnI_2.

Deliquescent. Easily sol. in H_2O.

Sp. gr. of ZnI_2+Aq at 19·5° containing:

23·1	42·6	56·3	63·5	76·0 % ZnI_2.
1·2340	1·5121	1·7871	1·9746	2·3976

(Kremers, Pogg. **111**. 61.)

Sp. gr. of ZnI_2+Aq at 19·5° containing:

5	10	15	20	25 % ZnI_2,
1·045	1·091	1·140	1·196	1·255
30	35	40	45	50 % ZnI_2,
1·368	1·390	1·420	1·560	1·650
55	60	65	70	75 % ZnI_2.
1·754	1·875	2·020	2·180	2·360

(Kremers, calculated by Gerlach, Z. anal. **8**. 285.)

Sol. in $(NH_4)_2CO_3$+Aq.

Sol. in alcohol.

Zinc *tetra*iodide, ZnI_4.

Known only in aqueous solution. (Baup, Repert. **14**. 412.)

Zinc iodide ammonia, ZnI_2, $4NH_3$.

Decomp. by cold H_2O. Easily sol. in acids and NH_4OH+Aq. (Rammelsberg, Pogg. **48**. 152.)

ZnI_2, $5NH_3$. Decomp. by cold H_2O. Sol. in NH_4OH+Aq. (Rammelsberg.)

Zinc nitride, Zn_3N_2.

Decomp. by H_2O with the greatest violence. (Frankland, Phil. Mag. (4) **15**. 149.)

Zinc oxide, ZnO.

Insol. in H_2O. Some preparations of ZnO are sl. sol. in H_2O, never, however, in less than 1 million pts. H_2O. (Bineau, C. R. **41**. 510.) Easily sol. in acids, even after ignition. Easily sol. in acids, even H_2SO_3, or H_2CO_3+Aq. When moist is easily sol. in KOH, NaOH, and NH_4OH+Aq, but only sl. sol. therein after ignition. Partially repptd. from solution in NH_4OH+Aq by dilution with H_2O.

Anhydrous ZnO is insol. in dil., but sol. in conc. alkali hydrates +Aq, but the hydroxide is easily sol., even in dil. alkalies +Aq. (Fremy, A. ch. (3) **23**. 390.)

Very sl. sol. in NH_4OH+Aq. After ignition its solubility is greatly increased by traces of K and NH_4 salts. Phosphates have the strongest action, then, in the following order: arsenates, chlorides, sulphates, nitrates, acetates, carbonates, tartrates, citrates, and sulphates. Succinates and benzoates increase the solubility in NH_4OH+Aq, only when it is very dil.; borates, iodides, chlorates, arsenites, gallates, and oxalates do not increase the solubility. (Schindler.)

Solubility in KOH, NaOH, and NH_4OH+Aq.

An excess over 4 mols. KOH to 1 mol. ZnO is necessary for solution, but that excess may be neutralised after solution, until only 4 mols. are left, without pptn. of ZnO. Solution is pptd. by addition of 12 vols. H_2O. KOH+Aq containing 16·5 g. KOH to a litre H_2O is the weakest solution which will dissolve ZnO. Three times as much alkali are necessary for solution at 50° as at 16-17°. Less excess of NaOH than of KOH is necessary. 3 mols. NH_4OH will dissolve 1 mol. ZnO, and the temp. and dilution are in this case of little influence. (Prescott.)

Sol. in hot NH_4Cl+Aq, either when moist or dry.

Somewhat less sol. in NH_4NO_3+Aq.

Somewhat sol. in water-glass+Aq. (Ordway.)

Slowly sol. in cold, easily in hot NaCl+Aq. (Siersch, J. B. **1867**. 255.)

Sol. in methyl amine, but insol. in amyl amine+Aq. (Wurtz.)

Sol. in boiling KCN+Aq.

Sol. in boiling $Fe(NO_3)_3$, and $Pb(NO_3)_2$+Aq with pptn. of oxides. Not attacked by $Co(NO_3)_2$, $Ni(NO_3)_2$, and $Ce(NO_3)_3$+Aq. (Persoz.)

Insol. in cane sugar +Aq. (Peschier.)

Tartaric acid somewhat hinders the pptn. of ZnO_2H_2.

1 l. solution containing 174·4 g. sugar and 14·1 g. CaO dissolves 0·24 g. ZnO. (Bodenbender, J. B. **1865**. 600.)

Min. *Zincite*. Sol. in acids.

Zinc *per*oxide, ZnO_2 (?).

Ppt. Decomp. by acids with evolution of H_2O_2. (Haass, B. **17**. 2249.)

ZnO_2, ZnO_2H_2. Insol. in NH_4OH+Aq. (Kouriloff, A. ch. (6) **23**. 431.)

Zinc oxybromide, $ZnBr_2$, $ZnO+13H_2O$.

All oxybromides are sol. in KOH and NH_4OH+Aq. (André, C. R. **96**. 703.)

$ZnBr_2$, $4ZnO$+10, 13, and $19H_2O$. Decomp. by H_2O into—

$ZnBr_2$, $6ZnO+35H_2O$. (André.)

$ZnBr_2$, $5ZnO+6H_2O$. (André.)

Zinc oxybromide ammonia, $ZnBr_2$, $3ZnO$, $2NH_3+5H_2O$.

Decomp. by H_2O. (André, C. R. **96**. 703.)

Zinc oxychloride, $ZnCl_2$, $9ZnO+3H_2O$.

Insol. in H_2O. Less sol. in NH_4OH+Aq than $ZnCl_2$, $3ZnO+2H_2O$, but easily sol. in acids. (Schindler.)

$+14H_2O$.

$2ZnCl_2$, $9ZnO+12H_2O$. Insol. in hot or cold H_2O. (Habermann, M. **5**. 432.)

$ZnCl_2$, $8ZnO+10H_2O$. (André.)

$2ZnCl_2$, $5ZnO+26H_2O$. Sol. in KOH or NH_4OH+Aq. Decomp. by H_2O into—

$ZnCl_2$, $4ZnO+11H_2O$. (André, A. ch. (6) **3**. 94.)

$ZnCl_2$, $6ZnO+6H_2O$. Insol. in H_2O. (Kane, A. ch. **72**. 296.)

$ZnCl_2O$, $3Zn+4H_2O$. Sl. sol. in H_2O; more sol. in $ZnCl_2$+Aq.

Easily sol. in acids, or NH_4OH, or KOH+Aq. (Schindler, Mag. Pharm. **36**. 45.)

$+5H_2O$ and $8H_2O$. (André, A. ch. (6) **3**. 94.)

Zinc oxychloride ammonia, $6ZnCl_2$, ZnO, $12NH_3+4H_2O$.

Decomp. by H_2O and boiling alcohol. (André, A. ch. (6) **3**. 90.)

$ZnCl_2$, $3ZnO$, $2NH_3+5H_2O$. Decomp. by H_2O. (André.)

$ZnCl_2$, $2ZnO$, $2NH_3+3H_2O$. (André.)

$6ZnCl_2$, $3ZnO$, $10NH_3+13H_2O$. (André.)

$4ZnCl_2$, ZnO, $8NH_3+2H_2O$. (André.)

Zinc oxyiodide, ZnI_2, $3ZnO+2H_2O$.

Insol. in cold, sl. sol. in boiling H_2O. (Müller, J. pr. **26**. 441.)

Zinc oxyphosphide, ZnP_2O.

(Renault, A. ch. (4) **9**. 162.)

Probably is a mixture of zinc phosphate and phosphorus. (Vigier, Bull. Soc. **1861**. 5.)

Zinc oxysulphide, ZnO, ZnS.

Sol. in $HCl+Aq$. (Arfvedson, Pogg. **1**. 59.)

$4ZnS$, ZnO. Not decomp. by boiling $HC_2H_3O_2+Aq$. (Kersten, Schw. J. **57**. 186.)

Min. *Voltzite*. Sol. in $HCl+Aq$.

Zinc phosphide, ZnP.

Less easily attacked by $HCl+Aq$ than Zn_3P_2.

ZnP_2. Not attacked by hot $HCl+Aq$. (Hvoslef, A. **100**. 99.)

ZnP_4. Insol. in dil. $HCl+Aq$. (Renault.)

Zn_3P_2. Insol. in H_2O. Sol. in dil. HCl, H_2SO_4, or HNO_3+Aq, with evolution of PH_3. (Renault, A. ch. (4) **9**. 162.)

Zn_3P_4. Insol. in $HCl+Aq$. (Renault.)

Zinc selenide, $ZnSe$.

Cold dil. HNO_3+Aq dissolves out Zn, and Se separates out, which dissolves on warming as H_2SeO_3. (Berzelius.)

$+xH_2O$. Insol. in H_2O. (Berzelius.)

Zinc sulphide, ZnS.

Anhydrous. Insol. in H_2O. Sol. in $HCl+Aq$; insol. in $HC_2H_3O_2+Aq$. (Ebelmen, A. ch. (3) **25**. 97.)

Sol. in H_2S+Aq under pressure in a sealed tube. (Senarmont, A. ch. (3) **32**. 168.)

Min. *Blende, Sphalerite*. Sl. attacked by acids, excepting aqua regia.

$+\frac{1}{2}$, $\frac{2}{3}$, or $1H_2O$.

Pptd. ZnS. Insol. in H_2O, alkali hydrates, carbonates, and sulphides $+Aq$. Insol. in NH_4OH, or $(NH_4)_2CO_3+Aq$. Easily sol. in very dil. HCl, and HNO_3+Aq, but H_2S ppts. ZnS in presence of very dil. $HCl+Aq$, or H_2SO_4+Aq. (Eliot and Storer.)

More easily sol. in HNO_3+Aq than in $HCl+Aq$. (Fresenius.)

Only sl. sol. in acetic acid. (Wackenroder.)

When still moist is sol. in H_2SO_3+Aq.

Insol. in NH_4Cl or NH_4NO_3+Aq.

K_2S+Aq when added to $ZnSO_4+Aq$ produces a ppt. in presence of 10,000 pts. H_2O, and a slight opalescence with 20,000 pts. (Lassaigne.)

Slowly sol. in conc. $KCN+Aq$. (Halm, J. B. **1870**. 1008.)

Sl. sol. in Na_2S+Aq; sol. in $NaSH+Aq$. (Becker, Sill. Am. J. (3) **33**. 199.)

Zinc *penta*sulphide, ZnS_5.

Sol. in acids, with separation of S. (Schiff, A. **115**. 74.)

Zinc telluride, $ZnTe$.

Decomp. by acids. Sol. in Br_2+Aq. (Fabre, C. R. **105**. 277.)

Zincic acid.

Zinc hydroxide shows weak acid properties, and forms the following salts.

Ammonium zincate, $3ZnO$, $4NH_3+12H_2O$, $3ZnO$, $2(NH_4)_2O+10H_2O$.

Decomp. by much H_2O.

Barium zincate, $BaH_2Zn_2O_4+7H_2O$.

Decomp. by H_2O. (Bertrand, C. R. **115**. 939.)

Calcium zincate, $CaH_2Zn_2O_4+4H_2O$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Bertrand, C. R. **115**. 939.)

Cobaltous zincate, $xCoO$, $yZnO$.

Rinman's green. Sol. in acids. H_2CO_3+Aq dissolves out ZnO. (Comey.)

Potassium zincate, ZnO, K_2O.

Easily sol. in H_2O, but decomp. by boiling. (Laux, A. **9**. 183.)

$2ZnO$, K_2O. Decomp. immediately by cold H_2O. (Fremy, C. R. **15**. 1106.)

Sodic zincate, Na_2O, $2ZnO+8H_2O$ or $2NaHZnO_2+7H_2O$.

Decomp. by H_2O or alcohol. (Comey and Jackson, Am. Ch. J. **11**. 145.)

$2Na_2O$, $3ZnO+18H_2O$ or $Zn_3O_6Na_4H_2+17H_2O$. Decomp. by H_2O or alcohol. Insol. in ether. (Comey and Jackson.)

Strontium zincate, $SrH_2Zn_2O_4+7H_2O$.

Decomp. by H_2O. (Bertrand.)

Zirconic acid.

See **Zirconium hydroxide.**

Barium zirconate, $BaZrO_3$.

Insol. in acids. (Ouvrard, C. R. **113**. 80.)

Calcium zirconate, $CaZrO_3$.

Insol. in acids. (Ouvrard, C. R. **113**. 80.)

Calcium zirconate, acid.

Insol. in H_2O or $HCl+Aq$. (Hiordthal, A. **137**. 237.)

Cupric zirconate.

(Berthier, A. ch. **59**. 195.)

Lithium zirconate, Li_2ZrO_3.

Easily attacked by acids. (Ouvrard, C. R. **112**. 1444.)

Magnesium zirconate.

Insol. in H_2O or $HCl+Aq$. (Hiordthal, C. R. **61**. 215.)

Potassium zirconate.

Decomp. by $HCl+Aq$. (Knop, A. **159**. 44.)

Sodium zirconate, Na_2ZrO_3.

Decomp. by H_2O.

Na_4ZrO_4. Decomp. by $HCl+Aq$, and is dissolved by subsequent addition of H_2O.

$Na_2O, 8ZrO_2+12H_2O$. (Hiordthal.)

Strontium zirconate, $SrZrO_3$.

As $CaZrO_3$. (Ouvrard.)

Zirconium, Zr.

Crystallised. Attacked by conc. $HCl+Aq$ above 50°, but very slowly even at 100°; rapidly by hot aqua regia. Sol. in cold conc. $HF+Aq$. (Troost, C. R. **61**. 109.)

Very violently attacked by a mixture of HNO_3 and HF. (Berzelius, Pogg. **4**. 117.)

Amorphous. Slowly attacked by boiling aqua regia, H_2SO_4, or conc. $HCl+Aq$. (Berzelius.)

Easily sol. in HF or HNO_3+HF.

Zirconium bromide, $ZrBr_4$.

Very hygroscopic. Violently decomp. by H_2O to form oxybromide. (Melliss, Zeit. Ch. (2) **6**. 296.)

Zirconium chloride, $ZrCl_4$.

Sol. in H_2O with evolution of much heat to form $ZrOCl_2$. Sol. in alcohol. (Hinsberg, A. **239**. 253.)

Zirconium chloride ammonia, $ZrCl_4, 4NH_3$.

Decomp. by H_2O. (Paykull.)

Zirconium fluoride, ZrF_4.

Anhydrous. Insol. in H_2O and acids. (Deville, A. ch. (3) **49**. 84.)

$+3H_2O$. Sol. in H_2O, but solution decomposes by diluting, with pptn. of an insol. basic salt. Sol. in dil. $HF+Aq$. (Berzelius.)

Zirconium hydride, ZrH_2.

Not attacked by acids. (Winkler, B. **24**. 873.)

Zirconium hydroxide, $Zr(OH)_4$.

Insol. in H_2O or alcohol. Sol. in 5000 pts. H_2O. (Melliss.)

Sol. in acids, even oxalic or tartaric acid, when precipitated cold. If precipitated hot, it is slowly dissolved upon heating with conc. acids.

Sl. sol. in $(NH_4)_2CO_3+Aq$. Insol. in K_2CO_3 and Na_2CO_3+Aq. Insol. in NaOH, KOH, and NH_4OH+Aq.

Sol. in $(NH_4)_2C_4H_4O_6+NH_4OH+Aq$. Insol. in NH_4 salts$+Aq$.

Zirconium nitride.

Scarcely attacked by acids, aqua regia, and caustic alkalies. Slowly decomp. by long contact with H_2O. (Mallet, Sill. Am. J. (2) **28**. 346.)

Zirconium oxide, ZrO_2.

When ignited, is insol. in all acids except HF and H_2SO_4. Sl. sol. in HF; sol. in H_2SO_4 only when very finely powdered and heated with a mixture of 2 pts. H_2SO_4 and 1 pt. H_2O until the H_2SO_4 volatilises. (Berzelius.)

Zirconium ***per*****oxide**, ZrO_3.

(Cleve, Bull. Soc. (2) **43**. 53), or Zr_2O_5 according to Bailey (Chem. Soc. **49**. 150).

Not attacked by cold dil. H_2SO_4+Aq. (Bailey.)

Zirconium silicon oxide.

Min. *Zircon.* *See* **Silicate, zirconium.**

Zirconium oxy- compounds.

See **Zirconyl compounds.**

Zirconium sulphide.

Insol. in H_2O. Sol. in HF; slowly sol. in aqua regia. Insol. in HNO_3, HCl, H_2SO_4, or $KOH+Aq$. (Berzelius.)

Insol. in dil. acids. Sol. in conc. HNO_2+Aq (perhaps an oxysulphide). (Fremy.)

Zirconyl bromide, $ZrOBr_2+7H_2O$.

Sol. in H_2O. (Melliss.)

$+8H_2O$. Sol. in H_2O. (Weibull, B. **20**. 1394.)

Zirconyl chloride, $ZrOCl_2+4\frac{1}{2}H_2O$, $6\frac{1}{2}H_2O$, and $8H_2O$.

Efflorescent. Easily sol. in H_2O and alcohol. Very sl. sol. in conc. $HCl+Aq$. (Berzelius.)

$Zr_2O_3Cl_2$. Sol. in H_2O and alcohol. (Endemann, J. pr. (2) **11**. 219.)

$8ZrO_2, 7HCl$. Sol. in H_2O. (E.)

Zr_2OCl_6. (Troost and Hautefeuille, C. R. **73**. 563.)

$Zr_3OCl_4=ZnCl_4, 2ZrO_2$. Insol. in H_2O. (Hermann.)

Zirconyl iodide, $ZrI(OH)_3+3H_2O$.

Easily sol. in H_2O. (Hinsberg, A. **239**. 253.)

Zirconyl sulphide (?).

Decomp. by HNO_3 with separation of S. (Fremy, A. ch. (3) **38**. 326.)

APPENDIX

FORMULÆ FOR CONVERTING AREOMETER DEGREES INTO SPECIFIC GRAVITY.

n = no. of degrees on the areometer scale ; sp. gr. = specific gravity.

Areometer	Temp.	Liquids heavier than H_2O	Liquids lighter than H_2O
1. Baumé. (*a*) *According to Baumé's original directions.* For liquids heavier than H_2O. Sp. gr. of a solution of 15 pts. NaCl dissolved in 85 pts. H_2O at 12·5° $\left(d\frac{12{\cdot}5^\circ}{12{\cdot}5^\circ}=1{\cdot}1118988\right)$ = 15° ; H_2O = 0°. For liquids lighter than H_2O. Sp. gr. of 10 % NaCl + Aq at 12·5° $\left(d\frac{12{\cdot}5^\circ}{12{\cdot}5^\circ}=1{\cdot}0737665\right)$ = 0°; H_2O = 10°.	15°	$\text{Sp. gr.}=\frac{149{\cdot}05}{149{\cdot}05-n}$	$\text{Sp. gr.}=\frac{145{\cdot}56}{135{\cdot}56+n}$
(*b*) *Old Form.* Liquids heavier than H_2O, 10 % NaCl + Aq at 15° $\left(d\frac{15^\circ}{15^\circ}=1{\cdot}073350\right)$ = 10° ; H_2O = 0°. Liquids lighter than H_2O, 10 % NaCl + Aq = 0° ; H_2O = 10°.	12·5°	$\text{Sp. gr.}=\frac{145{\cdot}88}{145{\cdot}88-n}$	$\text{Sp. gr.}=\frac{145{\cdot}88}{135{\cdot}88+n}$
	15°	$\text{Sp. gr.}=\frac{146{\cdot}3}{146{\cdot}3-n}$	$\text{Sp. gr.}=\frac{146{\cdot}3}{136{\cdot}3+n}$
	17·5°	$\text{Sp. gr.}=\frac{146{\cdot}78}{146{\cdot}78-n}$	$\text{Sp. gr.}=\frac{146{\cdot}78}{136{\cdot}78+n}$
(*c*) *New Form.* So-called "Rational Scale." Liquids heavier than H_2O, H_2SO_4 + $Aq\frac{15^\circ}{15^\circ}=1{\cdot}842=66^\circ$; H_2O = 0°.	15°	$\text{Sp. gr.}=\frac{144{\cdot}3}{144{\cdot}3-n}$	
2. Beck. H_2O = 0° ; liquid of 0·850 sp. gr. $\left(\frac{12{\cdot}5^\circ}{12{\cdot}5^\circ}\right)$ = 30°. Scale continued above and below.	12·5°	$\text{Sp. gr.}=\frac{170}{170-n}$	$\text{Sp. gr.}=\frac{170}{170+n}$
3. Twaddle. H_2O = 0°. Each degree corresponds to an increase of 0·005 in the sp. gr.	Given on the instrument	$\text{Sp. gr.}=1{\cdot}000+0{\cdot}005n$	

TABLES FOR THE CONVERSION OF BAUMÉ DEGREES INTO SP. GR.

Since the original directions of Baumé there have been many slight modifications suggested, so that there are several varieties of Baumé hydrometers with somewhat varying readings, tables for the two principal ones of which are here given.

1. According to Baumé's original directions.

For liquids heavier than H_2O. Sp. gr. of 15 % NaCl + Aq $\left(\frac{12·5°}{12·5°}\right) = 1·1118988 = 15°$; $H_2O = 0°$.

Calculated according to the formula, sp. gr. $= \frac{149·05}{149·05 - n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
0	1·00000	20	1·15497	39	1·35438	58	1·63701
1	1·00675	21	1·16399	40	1·36680	59	1·65519
2	1·01360	22	1·17316	41	1·37945	60	1·67378
3	1·02054	23	1·18246	42	1·39234	61	1·69279
4	1·02757	24	1·19192	43	1·40547	62	1·71223
5	1·03471	25	1·20153	44	1·41885	63	1·73213
6	1·04194	26	1·21129	45	1·43248	64	1·75250
7	1·04927	27	1·22122	46	1·44638	65	1·77335
8	1·05671	28	1·23131	47	1·46056	66	1·79470
9	1·06426	29	1·24156	48	1·47501	67	1·81657
10	1·07191	30	1·25199	49	1·48971	68	1·83899
11	1·07968	31	1·26260	50	1·50479	69	1·86196
12	1·08755	32	1·27338	51	1·52014	70	1·88551
13	1·09555	33	1·28436	52	1·53580	71	1·90967
14	1·10366	34	1·29522	53	1·55179	72	1·93446
15	1·11189	35	1·30688	54	1·56812	73	1·95989
16	1·12025	36	1·31844	55	1·58471	74	1·98601
17	1·12873	37	1·33621	56	1·60182	75	2·01283
18	1·13735	38	1·34218	57	1·61923	76	2·04038
19	1·14609	...	...	...	...	...	...

For liquids lighter than H_2O. Sp. gr. of 10 % NaCl + Aq $\left(\frac{12·5°}{12·5°}\right) = 1·0737665 = 0°$; $H_2O = 10°$.

Calculated according to the formula, sp. gr. $= \frac{145·56}{135·56 + n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
10	1·00000	30	0·87919	50	0·78443	65	0·72577
15	0·96679	35	0·85342	55	0·76385	70	0·70811
20	0·93571	40	0·82912	60	0·74432	75	0·69130
25	0·90657	45	0·80616	...	...	...	...

2. According to the so-called Rational Scale.

Sp. gr. of $H_2SO_4 + \text{Aq}\left(\frac{15^\circ}{15^\circ}\right) = 1{\cdot}842 = 66^\circ$; $H_2O = 0^\circ$.

Calculated according to the formula, sp. gr. $= \frac{144{\cdot}3}{144{\cdot}3 - n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
1	1·007	18	1·142	35	1·320	51	1·547
2	1·014	19	1·152	36	1·332	52	1·563
3	1·021	20	1·161	37	1·345	53	1·580
4	1·029	21	1·170	38	1·357	54	1·598
5	1·036	22	1·180	39	1·370	55	1·616
6	1·043	23	1·190	40	1·384	56	1·634
7	1·051	24	1·200	41	1·397	57	1·653
8	1·059	25	1·210	42	1·411	58	1·672
9	1·066	26	1·220	43	1·424	59	1·692
10	1·074	27	1·230	44	1·439	60	1·712
11	1·082	28	1·241	45	1·453	61	1·732
12	1·091	29	1·251	46	1·468	62	1·753
13	1·099	30	1·262	47	1·483	63	1·775
14	1·107	31	1·274	48	1·498	64	1·797
15	1·116	32	1·285	49	1·514	65	1·820
16	1·125	33	1·296	50	1·530	66	1·842
17	1·133	34	1·308	...	...	...	...

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1804	...	48-51	...	...	...	...	...	...	...
1805	...	52-55	...	...	...	...	...	...	...
1806	...	56-60	...	...	...	...	...	...	...
1807	...	61-64	...	...	...	...	...	...	...
1808	...	65-68	...	...	...	...	...	...	...
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1814	...	89-92	...	...	3, 4	...	...	...	...
1815	...	93-96	...	...	5, 6	...	...	...	...
1816	...	(2) 1-3	...	...	7, 8	...	...	...	...
1817	...	4-6	...	1, 2	9, 10	...	...	...	...
1818	...	7-9	...	3	11, 12	...	...	...	...
1819	...	10-12	(1) 1	4	13, 14	...	...	...	...
1820	...	13-15	2	5	15, 16	...	...	...	1-3
1821	...	16-18	3	6	(2) 1, 2	...	...	...	4-6
1822	...	19-21	4, 5	7	3, 4	1, 2	...	...	7-9
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1824	...	25-27	7, 8	9	7, 8	7-10	...	...	13-15
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1826	...	31-33	10, 11	12, 13	11, 12	16-19	...	...	19-22
1827	...	34-36	12	(2) 1, 2	...	20-23	...	...	23-26
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18	...	...	...	18-20	...	...	...	...	11, 12	...
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63	...	5	...	53, 54	...	...	...	6, 7	...	25-27
66	...	6	...	55, 56	...	...	...	8, 9	...	28-30
69	...	7	...	57, 58	...	...	...	10, 11	...	(2) 1-3
72	...	8	...	59, 60	...	...	...	12, 13	...	4-6
75	...	9	...	61, 62	...	...	...	14, 15	...	7-9
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.	4	14	...	3, 4	12-14	...	...	...	...	22-24
.	5	15	...	5, 6	15-17	...	...	...	...	25-27
.	6	16	...	7, 8	18-20	...	...	...	...	28-30
.	7	17	...	9, 10	21-23	...	...	...	...	(3) 1-3
.	8	18	...	11, (3) 1	24-26	...	1	...	...	4-6
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Dr. Crawford	FEB 21 1916
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